Cultural Contact in Early Roman Spain through Linked Open Data

Thesis

Cultural Contact in Early Roman Spain through Linked Open Data

Thesis submitted to the Open University for the requirement of the degree of Doctor of Philosophy in Classical Studies

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Declaration

I declare that this thesis represents my own work, except where due acknowledgment is made, and that it has not been previously submitted to the Open University or any other institution for a degree, diploma or other qualification.

Abstract

The study of the Roman colonisation of the western provinces has produced much literature, especially about the processes of assimilation of Roman culture by indigenous communities and the cultural changes experienced by these under Roman influence. In Spain, traditional scholarship has looked mainly at the literary evidence for these processes, and therefore, the 'Roman' perspective of the conquest; current schools of thought argue for a new reading of the cultural processes rooted in theory and a contextualised analysis of archaeological data.

Traditional methods lacked the tools capable of making effective relationships within large amounts of data. Linked Open Data (hereafter LOD) technologies provide the means to resolve this deadlock. In the last decade, a number of projects have made available large amounts of data leading to a burgeoning of resources that rely on LOD technologies. The number of databases collecting information from Hispania is also continuously increasing. While these resources provide a vast amount of material, most of them do not meet open-access requirements, becoming information silos that hinder information accessibility and interoperability.

This research applies LOD technologies to align and connect web-exposed datasets (that follow or can be integrated to follow LOD standards) together with enhanced and aggregated information to investigate the dynamics of cultural interaction in the southern area of Spain between the 4th century BCE and the 1st century CE on the basis of epigraphic, monetary and sculptural evidence. Ultimately, this thesis examines the extent to which the application of LOD technologies can improve the way archaeological information is accessed, retrieved and analysed by means of a LOD dataset (ERUB) and the Cultural Contact Ontology (CuCoO).

To Gerardo Manuel Herráez Navarro, who always wanted me to become a doctor, wherever he is.

A Gerardo Manuel Herráez Navarro, que siempre quiso que me convirtiera en doctora, donde quiera que esté.

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Nomenclature

API	Application Programming Interface
BCE	Before the Common Era
CAA	Computer Applications and Quantitative Methods in Archaeology
CE	Common Era
CIDOC	*Comité International pour la Documentation*
CIL	*Corpus Inscriptorum Latinarum*
CRM	*Conceptual Reference Model*
CSV	*Comma-Separated Values*
GLAM	*Galleries, Libraries, Archives and Museums*
GUI	*General User Interface*
HTML	*Hypertext Markup Language*
HTTP	*Hypertext Transfer Protocol*
JSON	*JavaScript Object Notation*
LOD	*Linked Open Data*
MAN	Museo Arqueológico Nacional de España
MLH	*Monumenta Linguarum Hispanicarum*
OWL	Web Ontology Language
RDF	Resource Description Framework
RDFa	Resource Description Framework in Atributes
RDFs	Resource Description Framework Schema
SKOS	Simple Knowledge Organization System

SPARQL	SPARQL Protocol and RSDF Query Language
SQL	Structured Query Language
URI	Uniform Resource Identifier
URL	Uniform Resource Location
XML	Extensible Markup Language

Museum catalogues and web exposed databases

Ceres	Web browser for databases from Museums of Spain. Accessible at: www.ceres.mcu.es
Coinproject	http://www.coinproject.com/
Domus	Web browser for databases from Museums of Andalucía. Accessible at: http://www.juntadeandalucia.es/cultura/WEBDomus/domus.do
EDH	https://edh-www.adw.uni-heidelberg.de/home
Hesperia, Hesp.	http://hesperia.ucm.es/
Hispania EPigraphica	http://eda-bea.es/
MAN catalogue	Catalogue of the National Museum of Archaeology of Spain. Accessible at www.ceres.mcu.es
ResearchSpace	https://www.researchspace.org/
Wikimedia Commons	https://commons.wikimedia.org/wiki/Main_Page

List of abbreviated URIs by prefix

Resource	URI	Prefix
Arachne	https://arachne.dainst.org/	arachne:
BM thesaurus	http://collection.britishmuseum.org/id/thesauri/script/latin	bm/id/thesauri/script/latin:
CVB	http://cvb.vrbanitas.es/mostrar_ciudad/	cvb:
Dbpedia resource	http://dbpedia.org/page/	dbpedia:
EDH inscription	https://edh-www.adw.uni-heidelberg.de/edh/inschrift/	edh/inschrift:
EDH Place	https://edh-www.adw.uni-heidelberg.de/edh/geographie/	edh/geographie:
EDH Person	https://edh-www.adw.uni-heidelberg.de/edh/person/HD003581/1	edh/person:
EDH Support	https://edh-www.adw.uni-heidelberg.de/edh/type_of_monument/	edh/type_of_monument:
ERUB	http://data.open.ac.uk/erub/	erub:
Nomisma	www.nomisma.org	nm:
DARE	https://imperium.ahlfeldt.se/	dare:
Trismegistos	https://www.trismegistos.org/	tm:
Pleiades	https://pleiades.stoa.org/	pleiades:

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Chapter 1: Introduction

No man is an island entire of itself; every man
is a piece of the continent, a part of the main.
'No man is an island', John Donne

When you connect data together, you get power.
Sir Tim Berners-Lee

This thesis explores the utility of the application of Linked Open Data technologies (LOD) to archaeological research, by looking at the question of cultural contact in early Roman southern Spain (4th century BCE–1st century CE). It brings together archaeological evidence collected in different web-exposed datasets using the principles of the Semantic Web to explore the question of cultural interaction in antiquity. The thesis consists of ten different chapters, followed by a series of appendices that collect the results of the queries.

Chapter 1 forms this introduction; it offers an overview of the main research questions of this thesis, followed by an outline of its main topics: semantic technologies and the Roman colonisation of Spain. The chapter concludes with a brief examination of the study's aims and contributions.

Chapter 2 presents a literature review of 'Romanisation' theory in Spain since the introduction of the term in the early 19th century. The chapter discusses the number of models that emerged in European scholarship as a reaction to Romanisation theory as well as some of the more general critiques and responses to them. The chapter concludes by expanding on current cultural contact theories and exploring the potential benefits of their application in this investigation.

Chapter 3 presents an overview of the ethnic configuration of the southern area of early Roman Spain. After a short introduction to the subject, the chapter provides a discussion of current evidence in the fields of epigraphy, numismatics and visual arts that provide a new understanding regarding the cultural changes that occurred in the province before, during and after the Roman conquest.

Chapter 4 explores the growing interest and activity in the semantic in the last decade, a development that forms the context for the main aim of this thesis. To do this, the chapter dawns upon a variety of sources including broader investment and support by funders and networks such as CLARIN, Linked Pasts, Getty etc. reflecting on what kind of LOD technologies these projects apply. The chapter begins with an introduction to the Semantic Web underlining its differences with the traditional 'web of documents'. It then moves on to specify the technologies that make the Semantic Web possible including a brief overview of the latest projects developed in the field of archaeology and semantic technologies. The chapter concludes with a summary of the latest archaeological projects that incorporate semantic technologies and their visibility in academia.

Chapter 5 is the first of the three chapters focused on methodology (chapters 5, 6 and 7) and consists of a survey of the different digital resources applied in this thesis. It begins with a brief overview of the methodological procedure to then move on to an explanation of the processes required for the publication and consumption of LOD. It continues by providing a survey of the different digital resources drawn upon in this thesis, divided geographically into Spanish and international resources, assessing their utility according to Berners-Lee´s five-star criteria.

Chapter 6 is the second chapter in the methodological section. It begins with an overview of the procedures followed for handling the available data on the web for two sorts of evidence – epigraphy and settlement – including the problems encountered in each case. The chapter then goes on to discuss the measures taken for the collection and integration of new data from both written and digital sources. It provides an overview of the different mechanisms followed for the collection of online data as tabular data and its translation into a LOD format. Finally, it concludes with an explanation of the ERUB (Early Roman Ulterior-Baetica) dataset, a dataset created ad hoc for this research.

Chapter 7 is the final section on methodology, focused on the development of CuCoO (the Cultural Contact Ontology). The chapter begins with the rationale behind the design of CuCoO. It then expands upon the modelling of cultural contact in archaeological evidence, discussing recent approaches to this and the problems of generating a standardised terminology to represent cultural phenomena. It then provides an overview of the main classes and properties generated within CuCoO and the reasons behind them. The chapter concludes with an introduction to inference rules and a discussion of the rules developed for the generation of new data with CuCoO.

Chapter 8 is the first analytical chapter of this thesis. It explores the question of epigraphic contact in early Roman southern Spain through a series of queries run on the ERUB dataset. The chapter begins with an introduction to the procedures followed for the querying and evaluation of the method presented in the previous chapters. It then moves into a brief overview of the question of linguistic contact in antiquity that will provide a context for the exploration of this phenomenon in ERUB through two specific sorts of evidence: onomastics and coin legends. The chapter finishes with a series of conclusions regarding the benefits and pitfalls of the application of LOD technologies for the research question.

Chapter 9 is the second and final analytical chapter. Building upon the previous chapter, it explores the question of iconographic contact in early Roman southern Spain through a series of queries run on the ERUB dataset. The chapter aims to explore whether iconographic contact can be identified through SPARQL querying in a linked dataset and whether those conclusions can bring new insights on the utility of the method to explore this specific question. It begins with an introduction to the concept of iconographic contact to later explore the diffusion and adoption of iconographic types in coinage. This chapter applies Social Network Analysis (SNA) to map connections between different cities based on shared iconographic types.

Finally, Chapter 10 summarizes the findings of the previous chapters before going into the main question of this thesis: what the utility is (including benefits and pitfalls) of the application of LOD technologies for the study of cultural interaction in early Roman southern Spain. The conclusions reached raise important questions for future work.

During the course of this doctoral research, it has also been necessary to create a number of additional outputs to aid in the analysis of the application of LOD technology to archaeological datasets.

These are:

- CuCoO: an ontology[1] for cultural contact in antiquity
- ERUB: a LOD dataset with material evidence from early Roman Ulterior-Baetica collected in RDF format
- A collection of python scripts to translate tabular data into RDF
- Data from a survey of relevant resources available online for the study of early Roman Spain

1.1. Research questions:

Despite a growth in interest in the nature of Roman conquest in Europe in recent decades, the topic has not yet been examined through the possibilities offered by Linked Open Data (LOD) technologies, nor has it been explored through the lens of cultural contact theories. The primary aim of this thesis is to assess the utility of implementing LOD technologies in archaeological research to explore cultural contact in antiquity. In doing so, this thesis applies LOD technologies in the generation of a semantic dataset (ERUB) and a Cultural Contact Ontology (CuCoO) to identify cultural traits in the archaeological record of early Roman southern Spain, so that it can then be queried for instances that suggest cultural interaction. This process ultimately allows the examination of the method and of LOD to assess whether they can bring new insights to both our knowledge about cultural interaction in early Roman Spain and our way of approaching this question through digital technologies.

It is important to note that this thesis has a hybrid character that blends Digital Humanities and archaeological research, and this is also reflected in the research questions proposed.

[1] Ontologies are vocabularies that allow the modelling of any posible domain of knowledge, for the concept of Ontologies see section 4.3.3. and chapter 7 for the CuCoO Ontology.

In the first instance, this thesis aims to address questions related to the application of Linked Open Data technologies to archaeological data. The main therefore is: how can LOD technologies help in the understanding of cultural contact in early Roman Spain? This question may be expanded to the following:

1. To what extent is it possible to perceive the nature of the interaction between indigenous and Roman peoples through LOD technologies?
2. What are the strengths and limitations of applying LOD technologies as a method for accessing, querying and analysing archaeological data?

The aim of this research is to assess the utility of the method by applying it to a specific case study: cultural interaction in early Roman Spain. In order to facilitate addressing such a substantial question, this research focuses on two specific aspects of cultural contact: linguistic and iconographic.

The linguistic makeup of the peninsula before and after Roman conquest reflects the impact of cultural interaction especially in two fields: onomastics and legends on coins. Consequently, the research questions of the linguistic data are as follows:

1. How can cultural contact be perceived in onomastics?
2. What different phenomena of linguistic contact are reflected in the coin legends?

In terms of iconography, the integration of new patterns in the images used by a community has also been understood as evidence for cultural interaction; in this sense, this thesis aims to study how cultural contact can be identified in the transmission of iconographic patterns between different communities using Alfred Gell's (1989) theory on the agency of art, setting out to address the questions:

1. How is cultural contact related to the diffusion and adoption of iconographic types in the numismatic record?
2. How is cultural contact reflected in the different cultural influences that can be identified in the sculptural record?

1.2. Introduction to semantic technologies

The World Wide Web has demonstrably transformed the way people share information, making data accessible at an ever-growing scale. This development has also allowed new types of applications that go from generic linked data browsers – that start from one database and connect related data sources – to linked data search engines that allow the user to query aggregated data (Bizer et al. 2009, 1-2). The possibility to upload linked data to the web in a standardised format that can later be queried and exported has been developed under the auspices of the Semantic Web community. Semantic technologies allow the researcher to connect information from different sources that have historically not been interrelated and provide the data with some context. These developments have changed the way in which data is processed, analysed and queried in all disciplines of research but especially in those that require the contextualisation of the evidence as is the case in archaeological research. In this field, the ontological turn and post-processual archaeology have emphasised the importance of studying objects in context.[2]

The term Linked Open Data refers to an ensemble of technologies, data and community effort that allows the user to produce, model and publish structured data on the Web in an

[2] Post-processual archaeology is a movement that originated in the 1980s in the UK that emphasises the subjectivism of archaeological interpretation. Other trends within this movement include structuralism and Neo-Marxism. The ontological turn in archaeology moved the standpoint from people to the object itself.

open and linked format. In recent decades, these practices have been adopted by several data providers triggering the emergence of a global information space known as the web of data. It is important to note here the difference between Linked Data (LD) and Linked Open Data (LOD). Although they are related and are sometimes used indiscriminately, LD and LOD do not necessarily refer to the same concept. LD includes the paradigm, principles and technologies that make Linked Data possible and should be differentiated from 'linked data' in lower case which refers to the actual data on the Web. In the same way, Linking Open Data refers to the community effort aimed at publishing freely accessible and reusable interconnected data on the web and should be differentiated from Linked Open Data, the result of the above-mentioned community effort.

The five-star criteria for publishing LOD on the Web according to Tim Berners-Lee (2010) are:

- Data need to be available on the Web, ideally under an open license
- Data should be available as structured data, rather than, e.g., JPEG or PDF
- Data should be available in a non-proprietary format (e.g., CSV file)
- Data should be published following open standards from the W3C (such as RDF and SPARQL)
- All of the above and links to other LOD

The system is cumulative, so that each of the requirements presumes compliance with the previous one. In order for data to be fully considered as LOD, the five criteria need to be met. The evolution of semantic technologies is making the accomplishment of these steps progressively easier.

Having explained the fundamentals of LOD technologies and the Semantic Web, it seems reasonable at this point to provide a brief summary of the potential benefits of this methodology which will be assessed in the course of this thesis. The following points address the potential benefits of using LOD technologies distinguishing between the pre-requisites of applying LOD (which provides additional benefits) and the benefits created by the application of it.

Prerequisites:

1. Modelling of the data: in order to publish data in a structured format, it needs to be modelled first, normally through the application of a thesaurus (lists of terms) or, in the best case, ontologies. The modelling of the data allows the structuring of information. Ontologies allow a common modelling of information between software agent and user; furthermore, the use of ontologies allows one to identify internal inconsistencies in the data.

2. Open access format: once the data is structured and in a non-proprietary format (e.g., Coma Separated Values (CSV)) it should be published online under an open-access license allowing data access, sharing and processability.

3. Suppression of storage limitations: the publication of data online in open-access forms diminishes the space limitations that internal memory presents in traditional databases, since the information is stored on the web.

Benefits:

1. Processability: the prerequisite of allowing access to information and providing it in a non-proprietary format allows the automatic processing of data by the user, e.g., by the application of relational analysis, statistics or result visualisation. In the case of archaeological research traditional data management systems still present difficulties in terms of accessing and sharing information (Reinhard 2014). These are mostly related to the different formats in which the data is stored, and the limited access granted to the data: it tends to be available only to specific researchers after tedious application processes. The query language for Linked Data (SPARQL) allows the querying of information across repositories and provides results in different formats including CSV. CSV allows easy processing of information by open-source tools, avoiding complex, time-consuming and expensive proprietary software.

2. Interoperability: as larger amounts of structured data are made available online in standard formats, data can be linked by creating connections between different concepts, allowing greater interoperability between the information. The possibility to link data coming from different resources allows cross-search queries over different data repositories, the so-called 'federated queries'. Federated queries allow the consultation of data contained in different repositories without the necessity to copy or ingest them into a local store. The possibility of incorporating restricted-access data in Open Linked databases brings in new evidence that contextualises the original data.

3. Modelling flexibility: RDF (Resource Description Framework), the standard format to represent LOD, provides more flexibility to model any possible relationships between data items than traditional methods (i.e., relational databases) since it is not constrained to a pre-defind data strcuture. RDF allows the representation of 'relational table modelling' (i.e., row, column, value) but also 'tree' data, and hierarchical and non-hierarchical relationships. Since the data model is not constrained to a defined structure, the user has more flexibility to map any possible relationships between the entities without having to respect pre-established labels and 'data columns.' Furthermore, by the use of URIs as keys, RDF allows the easy aggregation of further information into the graph dataset, making it easier to extend the structure and content of the data set.

4. Inferencing: the use of ontological modelling in LOD has been considered to facilitate information inferencing (Allemang/Hendler 2008). Inferencing means the deduction of information that is implicit in the original data. The generation of new information by LOD inferencing has been previously discussed; the main arguments against LOD inferencing tend to question, first, whether the data produced by the inference is entirely new information as it is generated through a Rule Language based on previously specified chain of properties, and second, the accuracy of the results (Isaksen 2011, 154). As the whole process depends on a chain of reasoning, if one only link in the chain is not correct, then the whole inference is not valid. Leaving aside the prospect of using inferencing to generate new information from a source dataset, there is also the possibility to use ontological inferencing rules to generate new data, which is not necessarily unknown, but was not explicitly part of the source dataset. Whereas this does not

necessarily mean the generation of new information, it does facilitate the generation of new data through rule-based reasoning. The benefits of this approach will be further discussed in Chapter 7.

5. Research sustainability: LOD implements the sustainability of the research not in terms of its survival on the web, since this only depends on the publisher means to guarantee its persistence, but in terms of the reutilisation of the information by others. The publication of research licensed and authorised in open access on the web allows its processability and reutilisation by others. This means that new research can be built upon already existing information which can be accessed and processed and not necessarily made from scratch. The reutilisation of larger dumps of data not only implements research demonstrably, but it also guarantees the survival of information that may be used in further projects in the future.

The following chapters (especially those involved in the methodology – 5, 6, 7 – and the evaluation of the method –8, 9–) will look more closely at the potential benefits of the application of LOD in archaeological research; by the generation of the ERUB dataset, and the implementation of the CuCoO ontology, to explore cultural contact in southern early Roman Spain. The aim of this thesis is not to treat the whole LOD implementation as a monolithic process but to look more closely at the benefits and costs of each of the elements involved. This will allow us to critically evaluate the efficacy of this method.

1.3. The Roman conquest of southern Spain

After Publius Scipio's conquest of Sagunto in 215 BCE from Hannibal, the Roman army kept spreading over the Iberian territories towards the west. In 214 BCE the town of Castulo (Linares, Jaén), the capital of the Iberian territory of Oretania, formerly a strong ally of Carthage, finally fell to Rome, which meant control over the mines of Sierra Morena. As the Roman troops progressed and suppressed various indigenous rebellions, the vast majority of indigenous towns fell under the power of the new invading forces. According to Livy (21.17.1), the Senate first assigned Hispania as a *provincia*[3] in March 218 BCE. Some years later, in 197 BCE, it established a new administrative order and divided Hispania into two provinces, Ulterior and Citerior (Livy 29.13). To delimit the administrative, juridical and military order of the new areas, Rome sent two praetors with *proconsular imperium*, C. Sempronius Tuditanus (Citeror) and M. Helvius (Ulterior). In that same year, an important indigenous rebellion started in Ulterior where the Turdetanians, commanded by Culcas and Luxinius, and with the support of Malaka (Málaga) and Sexs (Almuñécar, Granada), posed a strong resistance against Helvius (Livy 33.21). After quashing the rebellions, in the following decades, the province was enlarged into what is now Portugal and south-west Spain was progressively incorporated into the new Roman state models[4]. From 193 BCE, and during the expansion over Lusitania (Portugal), several indigenous attacks against the Roman troops took place. In 147 BCE the revolt of Viriatus, commander of the Lustanian tribes, had several victories in the eastern border of the province against Galba, gaining control over cities such as

[3] The term *provincia* originiated to desgin an area within which a Roman commander exercised military control and remained in this status, until it slowly became an administrative region (Richardson 1998, 7).
[4] The Hispanic provinces were ruled by Roman praetors with military power (proconsular imperium) and consuls in the most difficult scenarios. The magistracies were elected annually and could in some cases be extended by the Senate. The consuls and praetors controlled the army, the promulgation of edicts and the minting of coinage.

Tucci (Martos, Jaén) and reaching the area of Bastetania (Suet. Gal. 3) (Martinez Ruiz et al. 2003).

In 68 BCE, the quaestor Julius Caesar arrived in Spain to become in 61 BCE the new praetor of Ulterior. Caesar ended the rebellions in Lusitania and defeated Pompey in the civil war, after which Caesar developed a strong urbanistic policy in Ulterior giving special benefits to the allied towns. In the first stages of the conquest, urbanisation was generally grounded in the pre-existing nuclei of population which were differentiated depending on level of autonomy into different juridical categories: a) *civitates foederatae*, b) *civitates liberae et inmunes*, c) *civitates stipendiariae*, d) *municipia* and e) *coloniae* .[5] *Coloniae* were generally founded *'ex novo'* on the personal initiative of a magistrate either in a completely new territory (e.g., Italica) or in already-existing indigenous foci of population (e.g., Hispalis, Urso, Astigi etc.) In Caesar's times, some of these cities published their own municipal laws such as the well-known *lex Coloniae Genitivae Iuliae* from Urso (Osuna).

After the collapse of the Republican order and during the reign of Augustus, the province of Ulterior-Baetica emerged as an administrative entity with its capital in Corduba and constituted by a complex network of cities in which a multifaceted ethnic environment coexisted under Roman control. Between 12 and 2 BCE, with Augustus' administrative reorganisation, the territories in the east of the province – including the settlements of Castulo and Acci – were absorbed by the province of Tarraconensis, probably a stratagem of Augustus to control the income from the Sierra Morena mines (Keay 1998, 13), although they continued to belong to the cultural milieu of the southern province, and

[5] For the organisation of Hispania in *provinciae* see Knapp 1977.

they are considered as such in this thesis. As part of this reorganisation, some of the territories in the west also became part of Lusitania until Ulterior-Baetica was finally constituted coinciding in some measure with the current area of Andalucía and maintaining these borders until the end of the Roman Empire (Keay 1989, 13). An inscription from Augustus' forum in Rome (CIL VI.31267) records a dedication to the emperor by the province of Baetica probably around 2 BCE. It stood at the base of a statue which possibly depicted the emperor himself or a personification of Baetica and was set up were to recognise the 'beneficence and perpetual care' that the emperor had conferred upon Hispania Ulterior and for having 'pacified the province' (Alföldy 1992).

I would like to emphasize here that the term Ulterior-Baetica is not a modern creation to denote the period of transition from one administrative organisation to the following. Instead, it originated in antiquity and was used for a short period of time to denote the juridical demarcation of a new province over the territory of the former and after a major territorial and administrative reform, as Pliny attests in his Historia Naturalis '*in eo prima Hispania terrarum est, ulterior apellata, aedem baetica, nox a fine murgitano citerior aedemque tarraconensis ad purenai iuga*' (Pliny 3.4). Some authors support that the official name of the province for a short period of time was Hispania Ulterior Baetica (Caballos Rufino/ Lefebvre 186). In fact, Strabo (3.4.45) tells us how, after the subdivision of Ulterior by Augustus, the province kept its name, which coexisted with the new denomination long after administrative reorganisation. Because of the chronological limits of this thesis, it is more appropriate to refer to the province of Ulterior-Baetica, since both demarcations and territories are fundamental to understanding the cultural background of the territory and the communities who coexisted there before and after Roman arrival.

1.4. Cultural contact in early Roman Ulterior-Baetica through Linked Open Data

For most of the 19-20th centuries it was assumed that the victory of Scipio over the Carthaginians in 206 BCE finalised the Phoenician presence in the Iberian Peninsula and Phoenician influences were not considered significant in the later developments of the province (e.g., García y Bellido 1954). Nevertheless, recent scholarly work has challenged this belief: studies like R*oman Turdetania, Romanization, Identity and Socio-Cultural Interaction in the South of the Iberian Peninsula between the 4th and 1st centuries BCE* (2019), a volume on Paleohispanic languages and epigraphies edited by Alejandro Sinner and Javier Velaza (2019), and a recently submitted thesis by Javier Herrera Rando on *Cultura Epigráfica y Romanización en la España meridional (ss. II a.C. - I d.C.)* (2019) underline the importance of the Phoeno-Punic component in the cities of Ulterior during the Republican and early Imperial periods.

The abovementioned publications highlight a very significant Phoenician and Punic presence in the south of the peninsula that goes far beyond the chronological and geographical framework envisaged in the 19th century. These works have mainly focused on the study of epigraphic cultures in the Iberian Peninsula, leaving aside the information held by other sorts of material culture, for the study of the cultural dynamics in southern Spain after initial Roman presence. Because of this, this investigation is supported by the generation of a Linked Open Dataset that allows the simultaneous querying of three different sorts of evidence (numismatic, epigraphic and art-historical).

When Leif Isaksen submitted his thesis on *Archaeology and the Semantic Web* in 2011, three of the main conclusions reached were: 1) it is difficult to justify the level of investment in time and resources that applying semantic technologies requires, 2) there was a lack of concrete experimentation with the application of LOD technologies in archaeological research and 3) that LOD is much more concerned with openness and discoverability than with collaboration and inference. Building on these conclusions, the current study aims to advance the application of LOD technologies for archaeological research and investigate whether these conclusions are still valid. To address Isaksen's second conclusion, this research applies a systematic approach to the study of material culture evidence from early Roman Ulterior-Baetica (4^{th} century BCE-1^{st} century CE) through the application and deployment of LOD technologies (including a LOD dataset and SPARQL querying for archaeological analysis). It also investigates whether the level of investment in time and resources that LOD technologies require is justified in this case study (conclusion 1) and finally, if the fact that LOD was more concerned with openness and discoverability than with collaboration and inference has changed in the last 10 years and whether or not this research will benefit from that (conclusion 3).

Ultimately, this study explores the application of a novel digital method based on the deployment of Linked Open Data technologies to collect and ingest web-exposed datasets that follow or can be integrated to follow LOD standards, together with enhanced and aggregated information. In doing so, this research is the first of its kind to produce from scratch a LOD dataset (ERUB) supported by the development of an ontology for the study of cultural contact in antiquity (CuCoO). The implementation of CuCoO together with the assessment of the queries' results will allow the method to be tested in the modelling and identification of cultural interaction in the evidence collected.

Chapter 2: Theoretical Framework

Overview

One of the aims of this research is to look at the cultural dynamics that took place during the colonial encounter in the south of the Iberian Peninsula from the 4th century BCE to the 1st century CE by means of Linked Open Data. This was a period of intense cultural interaction between the indigenous communities in different areas of the territory and several colonising groups. Chapter 2 will explore how useful the model of cultural contact can be to explore the phenomena that at the time were being experienced by the population to provide a theoretical framework for this investigation. After reviewing the different theories proposed over time, it will configure the cultural contact model and its further development in current scholarship.

2.1. Theorizing Romanisation: Who we are and how we got here?

The concept of 'Romanisation' was brought to Spain by Eduardo de Hinojosa (1887, 125-133), a Spanish scholar specializing in Roman law. Following him, in the first half of the 20th century, the term began to appear in several works, including those by Costa (1893), Bosh Gimpera (1944), García y Bellido (1945), Sánchez-Albornoz (1949; 1956) and Domínguez Monedero (1984), to designate the integration of the Iberian Peninsula into the Roman world. Most of these works share a common depiction of the Roman period on the peninsula as a golden age of the region's history that involved strong cultural, political and social development (Cravioto/Ballesteros 2007). This concept of Romanisation remained unchallenged until recently, and the narratives of classical authors such as Appian, Livy, Pliny and Strabo considered authoritative sources. As Prieto Arciniega (1980), Jiménez (2008a) and Moreno Escobar (2016) have pointed out, Roman conquest was depicted in this literature as a 'mission civilisatrice' that was already articulated in Mommsen's and Haverfield's works and found its parallels in Spanish publications (e.g., Garcia y Bellido 1945; Blázquez Martínez 1964). These authors considered the Roman conquest as a one-way process in which most of the indigenous communities – 'uncivilised but intelligent' (Haverfield, 1915, 14) – adopted Roman rule voluntarily, having recognised the benefits of the new organisation (Moreno Escobar 2016).

Gozalbes Cravioto and González Ballesteros (2007) have identified two different traditions in this literature. On the one hand, the model that emphasises the triumph of Romanisation and its 'mission civilisatrice' as for example in the positive description of the intervention of Roman colonizers to supress the primitivism of indigenous communities by Costa (1898). And on the other hand, the model that focuses on the persistence or transformation of latent indigenous cultural traits and considers the Romanisation process to have failed (e.g., Bosh Gimpera 1964). This dichotomy can be understood through the lens of the situation in Spain at the time, when the tensions between centralism and autonomism were emerging (Gozalbes Cravioto/González Ballesteros 2007).

From the second half of the 20th century onwards, the progressive implantation of Roman law, language, economy and religion started to attract the attention of Spanish scholarship. This resulted in a series of publications that looked at the different processes that facilitated the first Roman settlements in Spain. Blázquez Martínez (1964) and García y Bellido (1967) analysed the legal aspects of the new foundations, their economic development, the Latinisation process and Blázquez (1981) looked at syncretism between

Roman and local religious rites. Approaches that questioned the 'unity' of the indigenous communities in Spain (e.g., Bosh Gimpera 1944) at the same time triggered the formulation of new hypotheses about the 'diverse character' of Roman impact in the provinces (Blázquez Martinez 1975). This approach motivated the publication of several studies on the cities of southern Spain and the myriad influences that can be traced in their archaeological record (Keay 1996a; Harrison 1988; Bendala 2004). Against the classical depiction of Baetica as the 'most Romanised province', Blázquez (1975, 56) underlined the prevalence of pre-Roman administrative elements until the Imperial age as well as the number of towns that remained without clear Roman legal status. Drawing on anthropological concepts, Fear (1996) criticised Hovarth's (1972) model of looking at the process in terms of 'colonialism' and 'imperialism' as too simplistic for understanding the complexity of cultural processes in Baetica (Fear 1996, 3-4) and emphasised the role of aspects such geography, different responses to Roman power and indigenous economic systems. The underlying model that Fear promoted was a bidirectional process of cultural interaction in which indigenous groups adopted some Roman ways while at the same time retaining some of their own, resulting in a new synthesis of both (Fear 1996, 275-276).

Borrowed from anthropological studies, the acculturation model also started to find support in Spanish scholarship (Moreno Escobar 2016). This emphasised the role of new populations incorporated into the Republic in the context of a specific socio-political organisation, thus acknowledging the singular ethnic and cultural background of the communities and contrasting with other theories that looked at the pre-Roman element as a homogenised substratum (Blázquez Martinez 1975). This perspective recognised different levels of intensity in the Romanisation process determined by the pre-Roman communities, the conditions of conquest and the period in which the territories were incorporated (Oltean 2007). Although the acculturation model has been mainly abandoned in Anglophone scholarship due to the prominent role given to local aristocracies (e.g., Webster 2001) and the pre-Roman background of indigenous groups as the main explanation for cultural difference between the provinces (Millett 2001), it still remains used in Spanish works alongside the Romanisation perspective.

Despite the fact that Romanisation has had its time in European scholarship, several arguments are still frequently used in its defence, especially in Spanish works. One of the most extended justifications considers that although the term is indeed obsolete and does not reflect the complexity of cultural processes, it can still be used when acknowledging its weaknesses (e.g., Moreno Escobar 2016, 68; Herrera Rando 2019). Works that use Romanisation theory within this frame claim to be far from the 'traditional' model and to acquire new approaches towards it leaving behind the 'imperialist' connotations of the term and reinforcing a new understanding of the process that acknowledges provincial and indigenous agency. Nevertheless, as Woolf puts it, ''Romanization' — in quotation marks — is far worse than Romanization, because it has all the sins of the former without its conviction' (Woolf/Versluys 2014). In my own view, the fact of acknowledging the weaknesses of a theory in reflecting complex cultural interactions does not endorse its use. Moreover, even when the weaknesses of the term are recognised, the use of the concept brings in a whole set of cultural implications that cannot always be ignored by the reader and quite often become implicit in the articulation of arguments.

Although the theoretical debate in Spain has not yet been as fruitful as in other countries, current advances in archaeological research, together with engagement with alternative disciplines and techniques for the study of the past, have promoted a reassessment of traditional scholarship together with a formulation of new theories and methods. These approaches reject traditional perspectives and depict the Roman conquest of the peninsula as a multidimensional process of multidirectional cultural interaction within the framework of hybridisation (Jiménez 2008), cultural contact (Sinner 2015) and bilingualism (Estarán 2016). Culture is represented as a dialectic construction of objects, rules and practices employed by the individual in a creative way and it is this individual in the final analysis who decides whether to incorporate the new cultural traits and, furthermore, how to incorporate them (e.g., Sinner 2015).

2.2. Post-colonial experience and discrepant identity: seeing life through a new lens

Post-colonial theory promotes a new reading of the Roman conquest of the west grounded in the experiences of native groups. It tends to emphasize the more negative aspects of Roman expansion such as violent conquest of indigenous land and imposition of institutional and administrative rules foreign to the indigenous communities (e.g., Mattingly 1997; Hingley 1997; Webster 1997). At the same time, it poses a strong criticism of Roman imperialism grounded in the work of scholars who advocated indigenous 'resistance' as a way of opposing imperial control (e.g., Benabou 1976). Nowadays, the post-colonial movement constitutes a big theoretical framework that has allowed the flourishing of very different theoretical models to explain Roman and native interaction in the provinces. Some of these models present a different approach to post-colonial views, while others still endorse some of its main premises.

In the late 20th and early 21st centuries, the idea of 'Roman culture' started to be understood as a fluid and complex set of cultural practices that adapted and changed across time and communities (e.g., Woolf 1995; Wallace-Hadrill 2008). This vision had its influence in further discussions on Roman identity. The main question was whether 'Roman identity' was a specific construct generated on the Italian peninsula and exported to the rest of the empire, or whether it was something more fluid and dynamic generated in different spaces with different forms of culture that were assimilated by the Roman Empire. Greg Woolf, one of the main initiators of this vision, considers Roman habits in the provinces to have been influenced by pre-existing provincial practices. These behaviours at the same time became part of the intrinsic Roman development in those places to later be spread across new territories, particularly in the period of the late Republic and early Empire (Woolf 2000). At that point, existing theories were no longer providing satisfactory answers to the questions that new archaeological evidence was revealing. This new archaeological data revealed the complexities of the question of identity such as bilingual inscriptions, local variations of Latin, clothing or mixed forms of pottery that could not be categorised within strict taxonomies. Provincial culture could no longer be understood as either the resistance to 'becoming Roman' or the acceptance of Roman rule. It posed the question of what it meant to become Roman and whether or not this ever had significance in Roman times (e.g., Woolf 1995; Wallace-Hadrill 2008).

In the early 21st century, the idea of 'becoming Roman' together with the notion of cultural identity started to be perceived as something highly complex and evolutionary that could involve the experience of not just one identity but the identification with several categories at once. This vision is close to the idea of 'cultural bricolage' proposed as a possible explanation for the cultural diversity of the Italian peninsula during the Roman period (Terrenato 1998), and underlines the necessity to leave behind the Romanised/non-Romanised dichotomy. Cultural change is no longer seen as a homogenous reality that affects all peoples in a similar way but as the result of a specific set of dynamics that might be determined by different variables such as elite/plebs, urban/rural, public/private, external/internal, man/woman and alive/dead (Terrenato 1998). Consequently, traditional perceptions of 'Roman' or 'indigenous' started to be challenged. As Hingley (2005, 91) puts it, scholarship started to reject the idea of a standardised 'Roman identity' that was conceived within the context of the empire as part of an imperial cultural system based on the perception of higher social strata – magistrates, soldiers and citizens – and totally alienated from the perception of lower strata and social minorities such as non-citizens, women or slaves. This vision had provided only a small and distorted perspective of the complexity of culture and social relations in the Roman world. What Roman scholarship used to understand as 'Roman identity' was itself a cultural construct of Roman authors that was later duplicated by classicists and inherited in modern times within the context of a colonizing discourse (Hingley 2005, 92).

'Discrepant identity', the conceptual model proposed by Mattingly and supported by other theorists such as Hingley, Barrett and Webster, constitutes one of the firmest oppositions against the Romanisation theory (Mattingly 2013). In his main work, *Imperialism, Power and Identity* (2013) together with a series of articles published in the first years of this century, Mattingly strongly criticizes the anachronistic and misleading character of the term and emphasises the importance of the local manifestations of culture that had been somehow neglected by Romanisation scholarship. 'Discrepant identity' underlines the discrepant experiences that indigenous communities had in the periphery of the empire in reaction to Roman rule. These experiences, says Mattingly, can unquestionably not be integrated into the generalising phenomenon of Romanisation because of their variety and complexity. In this way, the scholar draws attention to the individual experiences of Roman power (i.e., economic, socio-politic and geographical spheres) especially in non-elite contexts.

Against Mattingly's theory, one of the most serious criticisms is the difficulty to empirically validate the 'discrepant identity model'. There have been studies of identity based on the analysis of material culture that emphasize the wider discourses and ideologies that shape cultural identity rather than focusing on the constructed paradigm of 'Roman cultural identity' (e.g., Huskinson 2000; Revell 2016). Nevertheless, the difficulty of this theory lies in the complexity of categorizing identity shift. Cultural identity does not necessarily imply one categorisation of the one-self, but it can also mean the identification with several categories at the same time and the evolution of these as time passes. Furthermore, there is no such thing as 'becoming Roman' or reaching a final and definitive Roman identity. People and communities experience continuous changes in their adaptation to different social, politic, economic and even natural contexts.

Martin Pitts (2007) has made an important contribution to identity studies. His work constitutes a survey of all identity scholarship published in the Anglo-American landscape over the last decade. His final remarks underline the exaggerated attention put by this scholarship on the cultural component of identity that has motivated the continuation of Romanisation debate instead of moving scholarship forward. Pitt underlines the necessity to overcome the binary differentiation between Roman and native that characterizes traditional literature on both Romanisation and identity studies and encourages research into social minorities and under-represented issues (such as cultural identity, gender and class). These approaches have motivated new methodologies in which Romanisation is no longer understood as the integration of indigenous cultures into the context of Roman rule but as the configuration of a complex of local and foreign identities that might share Roman traits (Wallace-Hadrill 2008).

Together with the new models proposed in the field of identity studies, other methods have also emerged that have not yet had major repercussions in Roman studies; nevertheless, they can help in the understanding of particular examples. One of these is structuration theory, first developed by the sociologist Anthony Giddens. It is based on the analysis of two key elements – structure (society) and agents (individuals) – and how the interaction between these can have a direct effect on the creation and subsequent reproduction of social systems (Giddens 1984). According to Giddens, structure and agency are two symbiotic elements that cannot be separated but need to be studied together as part of a global arrangement. In structuration theory, the focus is not on how individuals are independently constituted, but how their grouped actions develop into an established set of social structures. In a Roman context, these practices and social structures are what triggered the expansion of *Romanitas* in the provinces. Structuration theory has been applied in different studies on Roman space (Laurence 2010), urbanism (Revell 2011) and material culture (Van Dommelen 2002), providing an insight into Roman expansion in Spain and Italy. One of the main problems that present itself in a Romn context when applying this theory is the fact that gaps still exist in our knowledge of the Roman world and how social structures were replicated over the provinces. Nevertheless, this model proposes an effective framework to examine global cultural change through the reproduction and engagement with Roman rule.

Together with structuration theory, the model of creolisation has been borrowed from other disciplines such as linguistics, ethnography and sociology and applied to the study of the Roman world to shed new light on the products of cultural interaction. Originally, the concept appeared in the 16th century to differentiate African-born slaves from Afro-descendants who were born in the New World and took part in the generation of the colonial upper-class (Stewart 2007). Later on, the concept was borrowed by linguistic studies to define a language or a collection of terms that were developed from a mixture of different tongues to become the working language of a community. Today, creolisation offers a new framework to understand new forms of identity and the generation of new forms of cultural behaviour through the intermingling and aggregation of different cultural traits. As Cohen (2007) poses it, individuals who take part in creolisation acquire an active role in the selection of elements from the donor culture endowing these with new meanings that are different from those they had originally and triggering the generation of new varieties that overtake prior manifestations. Another example can be traced in Ferguson's study of material culture in early African America (2012). This work examines the origins of African-American culture and demonstrates how African slaves assimilated European cultural traits and interpreted them in their own terms to generate new forms of culture. Therefore, what was first interpreted as a process of acculturation was actually a complex process of cultural negotiation in which elements such as identity, language and material culture were generated as a new form of 'creolised' African-American culture.

Jane Webster applied the model of creolisation to the understanding of the cultural processes that occurred in the provinces after Roman conquest. In her work 'Creolizing the Roman provinces' (2001), she considers traditional scholarship on Romanisation as an acculturation model that explains how provincial elites adopted Roman culture but does not necessarily explain the cultural behaviour of non-elite groups. Webster considers Roman provinces as ‘creolised’ instead of ‘Romanised’ since the creolisation model can bring a better understanding of the ‘multicultural adjustment’ that took place in these areas after Roman conquest. This perspective allows for a ‘bottom up’ approach, avoiding traditional elite-centred models (Webster 2001).

Nevertheless, the creolisation model did not prosper. It can be argued that there are major difficulties when applying a linguistic model to cultural interaction and exchange in very different spaces and times. Creolisation explains the emergence of new social and cultural forms developed from the master-slave relationship generated in North America and the Caribbean. However, this model can become too simplistic when applied to Romano-indigenous relationships in the provinces. Furthermore, it is impossible to identify a new hybrid culture from the combination of the former two, since, after Roman conquest, several cultural forms existed simultaneously within several communities, and the indigenous contribution slowly disappeared, at least in the Spanish provinces.

The creolisation model presents, in fact, many features in common with hybridisation theory (see Jiménez 2011). The concept of ‘hybridity’ emerged in the natural sciences and became more popular in 19th century discussions about the human race. The hybrid human was then understood as the product of relationships between two individuals of ‘pure race’ as well as a dangerous threat towards the neat classification of species (Jiménez 2011). At that time, the apparatus behind racial hybridity was transferred to cultural history constructs where cultural change was explained as a result of evolution (Jiménez 2011). The term acquired some relevance in post-colonial thought in the idea that culture is intrinsically hybrid (Bhabha 1994). In this sense, the concept has also been used in post-colonial archaeology as an interpretative construct to classify 'material objects incorporating elements of multiple existing stylistic or technological traditions' (Card 2013, 1). As we shall see later on this chapter, Alicia Jiménez (2008, 2011) has successfully proposed a new model for hybridised Ibero-Roman remains in the Iberian Peninsula. In addition to this, and in parallel to the concept of creolisation, both terms present strong biological associations as well as negative connotations when applied to people, which is why their application is still not entirely well-received by more traditional circles.

Finally, one of the latest (if not the last) theoretical propositions to approach the question of cultural interaction in the Roman Empire is the theory of globalisation, or its most recent adaptation 'glocalisation'. In the words of Van Alten (2017, 1), 'Glocalisation involves the adaptation of global expressions in local particularities.' Globalisation theory was developed to denote a process of interconnection among different localities and spheres such as gender, culture, capitalism, identity and population (Nderveen Pieterse 2009). The concept derived from an intention to emphasize the realm of the local within the study of the global and it has been applied in several disciplines from its origins in economic theory. It can have very different meanings depending on its context of application and it has lately been seriously considered for the study of cultural change in the ancient world (e.g., Pitts/Versluys 2015; Versluys 2014; Witcher 2000; Pitts 2008).

Nevertheless, like other theories above, glocalisation has also had its detractors. Woolf (1997; 2005), for example, pointed out the limitations of approaching cultural contact in the Roman world from the dichotomy of natives and Romans. Other critiques have pointed out the anachronistic nature of the term (Dench 2005) and the fact that the Roman world cannot be considered a global empire (Greene 2008).

From the late 20th century onwards, much attention has been paid to the nature of the elements that played a role in the Romanisation of the provinces. Recent developments in archaeological practice have placed a major interest in the role of material culture, and with it, anthropological and sociological aspects of cultural change (e.g., Woolf 1993; 2001a; 2001b; 2011; Jiménez 2008b, 2010; Sinner 2015). Current research advocates for a less polarised perspective than traditional approaches have adopted in the establishment of binary pairs such as: 'Roman' and 'native', 'civilisation' and 'barbarism' 'local' and 'foreign' and 'domination' and 'resistance'. New scholarship looks at the nature of 'Roman culture', more broadly defined, and the spread of it across the western provinces.

2.3. The Cultural Contact model: recapitulating

Having explained the different theories developed over time as alternatives to Romanisation as well as the strengths and weaknesses of each of them, the aim of this section is to conclude the chapter by exposing the model of 'cultural contact' as a valid and broad approach that allows the exploration of cultural dynamics in early Roman southern Spain drawing from the concepts explained above. Despite having been around a long time, the cultural contact model has not been well-used in archaeological research apart from significant exceptions which will be explained in this section. Because of this, my aim is not to discuss it as a well-established theory, but to expand upon its origin and further development and the reasons why I consider it the best theoretical approach in this case. During this discussion, other already-mentioned models such as acculturation will come into play, due to their relationship with the cultural contact model.

Over recent decades, the rapid technological development in both transportation and communication together with the enhancement of software and tools that provide access to the internet have brought people closer together than ever. New systems of communication are emerging that allow us to establish different ways to interact with people all over the planet at a level never envisaged before. Because of this, much attention in recent years has been paid to the processes that lead towards and result from contexts of cultural contact in disciplines such as anthropology, sociology and psychology. These studies look at the socio-cultural dynamics produced by situations of cultural interaction and cultural change at individual and community level (Xia 2009; Soltman 2013). Nevertheless, far from being a new phenomenon, cultural contact is attested worldwide from the development of the earliest complex societies, and it has been the subject of much archaeological research (e.g., Lyons/Papadopoulos 2002; Gosden 2004; Carstens 2006; Baltali 2007; Delgado/Ferrer 2007; Cusick 2015).

The concept of 'culture' in the context of archaeology appeared for the first time in the late 19th century German ethnography when cultural-historical approaches formulated a holistic perspective of what was denominated as an 'archaeological culture' (Trigger 2006, 232-235). This concept encompassed classified assemblages of material culture that were considered to be representative of specific communities in a determinate time and space (Shenan 1978). The cultural-historical approach established artefact typologies relating to style and production techniques, so that a repeated pattern in certain artefacts at a specific time and space was described as a 'culture', e.g., 'the Aztec culture' (Boas

1940, 530-534). On the other hand, changes in patterns of style and manufacture within a stratigraphic sequence were understood as a disruption or a replacement of the specific culture (Boas 1940, 534). This approach motivated the analysis of ‘cultural traits’ to establish cultural convergences and divergences among different material records (Baltali 2007). The main weakness of the ‘archaeological culture theory’, however, was the assumption that a determinate group of people can be defined by an assemblage of objects classified in a taxonomy. This approach considered cultures as constrained and static entities that could be classified and circumscribed within specific contexts.

Criticism of 19th century cultural evolutionism argued against the idea of taking elements from their context and classifying them according to an evolutionary trajectory (Boas 1940; Baltali 2007). Similar ‘cultural traits’ shared by different communities do not necessarily mean a common cultural or ethnic background. Instead, groups can take on cultural traits (Boas, 1940, 272) and these can be reinterpreted according to the environment of the borrowers and therefore integrated into pre-existing cultural systems (Boas 1940, 284). When the new elements are integrated into a borrowing cultural context, they are given new meaning and these are employed in the framework of culturally-driven activities (Baltali 2007, 5). Consequently, the only way to understand the integration of ‘cultural traits’ is by looking at the cultural context in which they were, first, generated and, second, integrated.

The Boasian archaeological concept of culture considers, on the one hand, that the material record of a community cannot be decontextualised and interpreted as the manifestation of a specific culture, and on the other, that ‘culture areas’ established from the analysis of the chronological and geographical distribution of 'cultural traits' do not necessarily equate to specific communities (Baltali 2007).

The concept of 'cultural contact' (CC) has therefore a slippery nature itself. Although it is generally used to describe cultural interaction of any character, there is no consensus for an effective definition in archaeology, and its connotations vary when used in different disciplines such as anthropology, where studies of CC draw upon theories of acculturation and assimilation, or sociology, where CC is explored through the lens of its consequences in modern society such as culture shock, cross-cultural communication and globalisation. Interested in both the cause and consequences of the phenomenon, archaeologists try to join these perspectives to explore the phenomenon in antiquity, attempting to model organic interactions into static archaeological evidence (Cusick, 1998, 13).

The question of cultural contact or 'culture contact' has its previous tradition in literature. In 1998, James G. Cusick edited the first volume on 'Studies in Culture Contact: Interaction, Culture Change and Archaeology'. In it, he defined culture contact as the 'predisposition of groups to interact with outsiders' (Cusick 1998, 16) and underlined the difficulties in understanding human history without acknowledging the role of culture contact. The whole postulate behind the volume is that 'no human society has ever existed, for any significant length of time, in isolation from others' (Cusick 1998, 15). Nevertheless, despite the fact that cultural contact is inevitable, and it has happened in all periods of human history, the processes by which it is manifested as well as the nature of interactions are highly variable.

The relationship between CC and colonialism has been widely studied in antiquity where the boundaries between the two are mostly unclear. In 2004 Gosden was one of the first to set a distinction by considering that, in opposition to CC, colonialism implied some degree of advantage or control of some groups over others (Gosden 2004). What is common to any of the definitions provided for cultural contact is that they all assume that such a cultural phenomenon means the existence of at least two different communities, or cultural groups that come into contact in different circumstances. The differentiation amongst groups has traditionally been carried out in archaeology by means of the identification of ethnic or cultural variation. Material culture has been traditionally involved in the identification and expression of ethnicity, producing two different views; on the one hand, the primordialist tendency characterised by the identification of cultural assemblages with people and traditions, and on the other, the constructivist tendency which identifies ethnicity as a dynamic, mutable and intangible social construct with permeable boundaries. The rejection of traditional culture-historical models which assign material culture assemblages to specific ethnic groups without further questioning the origin or uses of such objects has been going on for decades especially in the disciplines of ancient history and archaeology. As Mullen (2013, 4) states, 'it would seem now a cliché to reiterate that ethnicity is negotiated, multi-layered and context-specific'.

The concept of ethnicity became more broadly used in mid-20th century when processual archaeology rejected cultural-historical approaches and traditional-normative concepts of culture. At this time, 'ethnicity' became an aspect of social processes more related to social interaction than the static boundaries shaped by the concept of 'culture' in previous cultural-historical constructs. However, the relationship between ethnicity and material culture remained unexplored. Today, despite the term being more widely present in current scholarship, the relationship between ethnicity and culture remains problematic.

Recent scholarship on the question (see Mullen 2013; Malkin 2014; Luce 2014; Müller 2014) seems to agree that ethnicity is something related to ideas, language and discourse, rather than human DNA and genetic heritage. However, the problem appears when 'ethnic identity' is opposed to other cultural constructs such as 'cultural identity'. In her work on multilingualism and multiple identities in the Western Mediterranean, Mullen (2013) reflects upon the reconstruction of ethnicity and points to the current confusion in modern scholarship between both concepts. Among others, Mullen quotes Jones' treatise on 'the archaeology of ethnicity' (1997). In her work, Jones defines 'ethnic identity' as 'that aspect of a person's self-conceptualisation which results from identification with a broader group in opposition to others on the basis of perceived cultural differentiation and/or common descendent' (Jones 1997, xiii). Building on Jones, Mullen (2013) defines 'ethnic identity' as the 'self-conscious identification of a group with a series of cultural traits which differentiate it from other groups, plus notions of shared history, shared territory, kinship and common descent', making it clear that 'common descendance' is one of the features that characterize ethnicity. The concept of 'ethnic Identity' proposed by Mullen is, she says, not necessarily interchangeable with the concept of 'cultural identity'. She gives the example of Roman and Greek cultural identities which could be assumed by 'non-Greek' or 'non-Roman' communities without automatically including ethnic components.

Ethnicity is something that can be learned through communication and interaction, but, as Malkin (2014) has stressed, it has also been considered as 'primordial' from the earliest civilisations. Malkin (2014, 284) states that 'clearly DNA is irrelevant for the formation of historical groups, however if ethnic identity persists for some centuries and keeps functioning historically, then it becomes primordial both in terms of how outsiders see a group (external perspectives or 'etic') and when defined as such also from inside (self-expression of identity or 'emic')'. This means that ethnicity has something to do with what is there from the very beginning of the individuals, either if you are born with it, or it is part of your heritage from the beginning.

The problem persists when looking at ethnicity through material culture. As Malkin (2014, 285) reflects, 'if ethnicity is dependent on discourse and ideas, what could be the use of material evidence?' The general conclusion about this, supported by Mullen (2012) and ratified by Malkin (2014) and Hall (2002), is that any discussion of ethnic identity cannot be based on archaeological studies alone but requires ancient written sources as well. Despite the numerous attempts made to define concepts such as cultural identity or ethnicity, it still remains a pending subject especially in museology and museum cataloguing, where those pieces that display different ethnic influences can remain uncatalogued or be put into unhelpful mixed categories. The same problem now emerges with the semantic modelling of museum collections in which terms such as 'ethnicity' or 'ethnic group' are simply missing.

'Acculturation', already discussed in previous sections, needs to be brought into discussion again as one of the most recurrent concepts in studies on cultural contact. I will not repeat here discussion from the previous section, but it is important to note how acculturation and cultural contact seem to go hand in hand, especially in Spanish scholarship, where it is normally understood as one of the several forms in which cultural contact can be manifested. In his contribution to the volume *Roman and Native in the Low Countries* of 1984, S. E. van de Leeuw revised previous literature on acculturation (e.g., Redfield/Linton/Herskovits 1936; the SSRC seminar on acculturation 1954; Bee 1972; Ray 1974) and came up with a classification of four different phases in the acculturative process:

a) Diffusion of objects alone: in this phase, no ideas, knowledge or symbols are transmitted across 'the boundary' but only objects such as beads or pots. An example of this situation could be 'silent trading' (Renfrew 1978).
b) Diffusion of symbol/meaning when contact occurs; meaning is commonly transferred through the object or the behaviours of the participants.
c) Evaluation: at the time when meaning is transferred, evaluation occurs against the pre-existing context of the recipient culture.
d) Integration: a process of acceptance or rejection directly connected to the meaning of the object. Within this phase, there can also be different models of integration: incorporation, substitution, syncretism and reactive adaptation.

This taxonomy is part of the conceptual apparatus generated by anthropological studies with the aim of facilitating the understating of the acculturative process. However, despite the fact that the acculturation model contemplates a two-way process of cultural exchange, traditional approaches have mainly applied this construct to understand the processes of adaptation of the 'recipient culture' into the 'donor culture' (Cusick 2015). Redfield et. al (1936, 52) for example, in the taxonomy represented above, items C and D are still presented as one-way processes of interaction. Furthermore, the schema is fully orientated towards the dissemination of cultural traits, whether tangible such as objects or intangible such as symbols or meanings. As noted by many scholars in the past, acculturation studies tend to depict cultural change on the basis of transfer of 'cultural traits' among societies obviating or leaving aside other reasons why cultural traits appear in situations of cultural interaction (Cusick 2015). Another common feature of acculturation literature is ambiguity towards power relations in the culture contact process. The issue of power is normally omitted from consideration (e.g., Broom et al.,

1954) or dealt with as a secondary aspect (e.g., Redfield et al., 1936). The schema also demonstrates how the acculturation model presupposes cultural change either by means of diffusion of objects, symbols, evaluation or integration, and it does not theorise the process of cultural interaction itself.

Taxonomies such as this help in the understanding of the variables that intervene in a process of interaction. By combining the theoretical framework with my methodology and the exploration of the evidence, I have developed my own taxonomy to understand cultural contact in antiquity from the perspective of the cultural contact model. This taxonomy has been configured as an ontology, a model to represent knowledge used in Linked Open Data, namely the Cultural Contact Ontology (CuCoO). Later in this thesis, chapter 7 provides an insight into the development of CuCoO.[6]

In contrast to the taxonomy discussed above, the model of CC offers a looser framework through which to approach the process of cultural interaction since it does not presuppose any kind of cultural change in any of the communities involved. Furthermore, it allows the application of other theoretical models such as hybridisation or creolisation, on the understanding that different situations may require different conceptual frameworks.

Although literature in the field of cultural contact is significant, in archaeology it seems to have been neglected in recent decades. Although interest in cultural interaction never disappeared (e.g., Caldwell 1964; Willey/Lathrap 1956), there seems to have been an impasse in the last forty years until its recovery within the field of colonialism and archaeology by the already-mentioned work by Gosden in 2004. Despite this, there is

[6] See chapter 7 for the technical development and the rationale behind the Cultural Contact Ontology.

currently no consensus on a coherent theoretical framework of cultural contact in archaeology (Shortman and Urban 2015). In the past, more widely extended models in the fields of anthropology, history and sociology were adapted for the study of intercultural interaction in prehistory and early historic societal interchanges. Nevertheless, there is still a need for a theoretical model that gathers together and explains all possible scenarios of contact as well as their impacts across human history. Shortman and Urban (2015, 76) made an approximation towards a possible assemblage of basic principles in the field. Acknowledging the limitations of all conceptual models that can never be complete and the impossibility of keeping the balance between abstraction and simplification, both researchers emphasize the following:

1. labour control is important in hierarchy building
2. it is important to move the focus of interaction towards individuals as opposed to cultural groups
3. cultures are not homogeneous systems whose members partake in the same understandings
4. events in any area cannot be explained unless the nature of the interaction system in which those events occurred is understood
5. basic units such as stability and change are not individual cultures but of a network of co-interacting cultures.

Shortman and Urban (2015, 76), also theorize about the possible variations that may take place in processes of cultural interaction. In order to do so, the authors identify three general forms of interaction structures (egalitarian, coevolving and hierarchical) and point to factors that produce variations within them.

In Spain the term ‘contacto cultural’ within the field of archaeology and colonial studies appeared for the first time two decades ago. These studies (e.g., Alvar 1990; Arasa i Gill 1999) depict the results of CC as a bidirectional process in which both communities provide and receive influences instead of as a one-way phenomenon (Alvar 1990, 4). Nevertheless, they do not reflect the differences between cultural contact and acculturation models and still show some traditional premises, such as the idea that cultural interaction is generally motivated by the necessity for a group to obtain goods and traits that the community lacks (Alvar 1990, 3). Some scholars would argue that cultural contact is the product of a predisposition for a group to interact with the outsiders (Cusckin 2015). Whilst this statement may be true, and the necessity for cultural interaction can be understood as an innate feature of human character, there are many other possible factors that should be considered. What is certainly true is that once contact has been established, interaction becomes a two-way process in which either group can become ‘emissary’ or ‘receptor’. Therefore, what needs to be emphasised here is that the consequences of cultural interaction is not only experienced by the community that integrates the new ‘cultural traits’ but also by the community who promotes this diffusion (Alvar 1990, 4).

It has not been until recently that Spanish scholars have drawn on the theory of cultural contact to explain processes of cultural interaction in the north of Spain. Alejandro Sinner (2016), for example, investigates how it can be perceived in different sources of evidence (i.e., architecture, construction techniques, pottery, epigraphy) and the consequences of cross-cultural interaction in local communities on the site of Cabrera del Mar in the north-east. Sinner defines CC as ‘the interaction between two different societies and their members over a certain period of time, which need not automatically result in ‘cultural change'' (Sinner 2015, 4). Although Sinner develops a successful analysis of the CC processes that happened in Cabrera del Mar, CC theory is not well justified and supported in the study. Sinner's theoretical framework leaves unexplained what sort of 'cultural' features should be considered to understand two societies as different, and also, what he actually considers as 'societies'. From his paper, a sense of society can be inferred as the set of relations and activities amongst the individuals in a group which shaped daily life and enacted religious, economic and cultural practices.

However, in my view, 'society', in the sense that Sinner uses the term, is not entirely effective to differentiate between two communities that shared public spaces and cultural traits. Furthermore, the application of the cultural contact model should not stop in the north-east of the Peninsula, but it should be especially applied to the south, which is well-known as a favoured destination for the many different communities that navigated the *mare nostrum* over time. One of the main reasons for this was its privileged location — at the end of the *oikumene* — but perhaps, above all, its mineral and metal wealth (Domergue 1990; Schulten 1963). As the literary evidence attests, Phoenicians, Greeks and Carthaginians were on the peninsula long before the Romans, and their testimonies had already underlined the wealth of the silver reserves in the south west as attested by the testimonies of Strabo, (3.-2.8-9) and Pliny (37, 203) among others. The Phoenicians were the first to establish their settlements in Iberia, around the 8th century BCE. Some of their most famous foundations include the longest-standing cities in Ulterior-Baetica such as Cádiz or Huelva together with a dense network of colonies on the Andalusian coast. These peoples were interested in the trade of metals but also in many other agricultural products that would import from the eastern Mediterranean triggering the establishment of the first trade contacts with the Greeks (Dietler/Ruiz 2009).

Attracted by this economic relationship, the Greeks founded their only two colonies in the peninsula, Emporion and Rhode, both the first places to mint coins in Spain (Ripolles 2012). Following Phoenicians and the Greeks, Carthaginians were the next community to appreciate the possibilities offered by the Iberian land and established Carthago Nova in the current area of Sagunto, Valencia. The power of the Carthaginians over the territory soon became a threat to the Roman control of the Mediterranean. In order to solve this conflict, the Roman republic sent the first Roman expeditions to the peninsula leading to the establishment of the first Roman military encampments on the north-east coast at Emporio and Tarraco in 218 BCE. Despite the fact that the first Roman settlements were established on the north-east coast, the Romans quickly expanded over the territory until 19 BCE when the conquest was finished.[7] Traditional approaches often considered the Romanisation of the Iberian Peninsula to have started in 219 BCE just after the first arrival of Roman military units to Spain, but this could never be true since the idea of a 'Roman Empire' did not even exist yet, and the conquest of the first territories in Spain was carried out more as a defensive mission rather than a colonizing endeavour. This obviously does not mean, however, that there was no interaction or cultural contact between Roman soldiers/authorities and indigenous peoples. In fact, it has been argued for a much earlier exposition to foreign cultural elements from the central and eastern Mediterranean which would have been promoted by the Punic communities established in the area (Knapp 1977, 143).

[7] Key publications relating to the history of Roman presence in Ulterior Baetica include Le Roux, 1995 and Marín Díaz, 1988.

One should suppose that from the 3rd to the 1st centuries BCE important sectors of the population inherited different ethnic identities such as Phoenicians, Carthaginians, Greeks and of course, Italians or Italo-Romans. The ethnic richness of the province definitely conditioned the terms on which the cultural contact situations occurred as well as the products of such cross-cultural interactions. Because of this, we can no longer speak about Romanisation, since there is no such final 'Roman' product derived from this interaction. Other theoretical models such as creolisation, hybridisation or glocalisation explained above, although valid in terms of reflecting upon the complexities of the cultural encounter and offering alternative lenses thorough which to view it, are not the optimal approach in this case since they also presuppose cultural change and the existence of a two-level system of 'local' and 'global'. In my view, cultural contact theory constitutes the optimal conceptual framework to approach the study of cultural processes in the south of early Roman Spain from the 4th century BCE to the 1st century CE, because:

a) It is not an anachronistic theory taken originally from a modern context adapted into the understanding of cultural dynamics in antiquity (like globalisation or creolisation), nor it is a new-configured word created ex-novo for the denomination of specific cultural relations that existed before the term itself (e.g., glocalisation). It is a model to approach cross-cultural interaction, a reality in human civilisation from its very origins.

b) It does not presuppose cultural change nor the confluence of 'local' or 'global' influences. Since it would neither be possible to consider as 'global' cultural substrata as different as 'Punic' or 'Roman' nor as local a cultural amalgamation of different communities with different ethnicities and identities.

c) The objective of this thesis is not to look at the results and further changes that happened in the province after Roman conquest, but to study the cultural changes specifically in the moment in which cultural interaction occured without presupposing cultural change nor the evolution towards a globalised or Romanised model.

d) It has been argued that the cultural change of the Iberian Peninsula started just after the arrival of the Romans to the peninsula; see, for example Knapp 1977, 143: 'The process by which much of Spain became truly Roman during the Early Empire began immediately upon the arrival of Cn. Scipio in 218'. Nevertheless, whereas a set of changes did begin just after the arrival of Scipio, it was not until much later that we can speak about an internationalisation of Roman civilisation (Knapp 1977, 144). When the Roman army arrived in Spain for the first time, during the last two centuries of the Roman Republic, there were divergences among the different communities of the supposedly unified Italian peninsula. This ultimately led to a period of crisis from the 1st century BCE until Augustus' victory at Actium in 31 BCE. Because of this it is hard to believe that Italic or Roman immigrants who arrived on the peninsula considered themselves as representing a unified ethnic identity as would happen later in the Roman Empire (Revell 1999; 2016). Because of this, the idea of a Roman Empire was not even defined, and these 'colonising groups' had not even formalised their cultural character as part of a colonising empire. Furthermore, the first administrative organisation was established in Spain even before Rome developed its own provincial administrative machinery. Because of this, the term 'Roman' is arguably inappropriate and 'Romanisation' should not be applied in this context.

2.4. Conclusions

This chapter constitutes a revision of the term 'Romanisation' from its origin to its application in most recent scholarship. It has been demonstrated that it is no longer suitable for understanding a multifaceted and very complex set of cultural interactions. Other models such as creolisation, structuration or hybridisation have also been discussed as ways to understand varieties of this phenomenon in the different areas.

In contrast, the cultural contact model offers a broader framework in which not just one, but several other theories can be applied to try and understand the processes in the different territories without presupposing cultural change in the context of cultural interaction.

Despite the fact that the reassessment of the concept of Romanisation seems to be over in Anglophone scholarship, Spanish academia has still not engaged in a through reassessment of the Romanisation model and the literature produced in this context that can only be possible through a systematic re-examination of the vast archaeological evidence that the peninsula preserves. One of the possibilities to do so is offered by digital technologies and, more specifically, LOD resources, as we shall see in the following chapters.

Chapter 3: The cultural context of Ulterior-Baetica

Overview

Chapter 3 offers a brief historical insight into the configuration of Hispania Ulterior-Baetica and some of the main events of the first years of Roman occupation. It discusses the evidence provided by epigraphy, numismatics and visual arts and some of the latest conclusions reached in these fields to stipulate a starting point fundamental to understanding the cultural configuration of the province which is directly related to the evidence collected for the purposes of this research and will be discussed in later chapters.

3.1. Ethnic coexistence in Ulterior-Baetica

What became the province of Ulterior-Baetica was a territory already inhabited by several indigenous communities clustered into Iberian and Turdetanian ethnicities and colonial groups traditionally shaped by Greek, Phoenician and Roman influences. Nevertheless, ethnic clustering is always a problematic matter and the concept of 'Iberian culture' is in itself a tricky one. The term comes from the Greek historians, who gathered within this word an amalgamation of different groups in several parts of the peninsula. It is, therefore, a denomination of colonial character given to the area by a foreign group dating back to at least the mid 6th century BCE that has geographical implications and was never used by the indigenous inhabitants of the peninsular south (Jiménez 2008a, 75). Within the term 'Iberians', and just in the southern area of Spain, Greek authors such as Herodotus or Hecateus of Miletus included Turdetani (in the Guadalquivir area), Bastetani (in the south east) and Oretani (Oretum: Sierra Morena). It is true that these communities shared a common cultural substratum as reflected in elements such as government, funerary traditions and material culture (e.g., ceramics, weapons and jewellery: see López Domech

1996 for the Oretani). Nevertheless, it is unknown to what extent these groups identified themselves as part of a single communal identity. Furthermore, the study of the evidence from Ulterior-Baetica, reveals very different cultural patterns to those identified in the northern province of Tarraconensis where the communities were also designated as Iberians.[8] This is supported by the two different writing systems used in Northern and Southern Iberia. Furthermore, the latest evidence seems to support the existence of a different language in the area of Turdetania (Correa et al. 2000). Because of this, current scholarship tends to separate the communities in the western area of Ulterior-Baetica from the other Iberian groups, and these are no longer considered by scholars to be part of the Iberian *koiné* but as independent communities which were subject to significant influences from the Phoeno-Punic coastal cities (De Hoz 2011, 27).

Traditional perspectives on the ethnic distribution of peoples in southern Spain before the arrival of Romans often locate the Turdetanian culture in the period that goes between the end of Tartessos —and the dissolution of certain Phoenician communities (6th century BCE)— and the beginning of the Roman period (3rd century BCE). Nevertheless, recent archaeological scholarship is sceptical about the idea of an indigenous crisis during the 6th century BCE (Jiménez 2008a, 71; Bendala Galán 1994, 67). In the same way, the beginning of the Roman period tends to be related to the establishment of certain Roman colonies such as Colonia Patricia and a rupture with previous indigenous prominence. Nonetheless, the study of material evidence coming from post-Roman populations has revealed continuity with preceding cultural periods and the reformulation of certain

[8] The study of the Iberian communities in the peninsula has been subject of much scholarship, key volumes in this regard include Aracnegui, 1998; Olmos/Santos Velasco, 1997 and Ruiz Rodríguez/Molinos Molinos 1998.

cultural patterns in subsequent times (Jiménez 2008a, 71; Keay 1997, 31, 36; Bendala Galán 1981, 37-45).

All this enhances the complexity of studying the communities that inhabited the area before the Romans. Moreover, even more difficulties are added by Graeco-Roman written sources (García y Bellido 1945). As Gardner et al. (2013, 7) recently pointed out, textual evidence should be carefully considered when looking at ethnic configurations. In most cases, Roman sources show an external perspective and constitute categorisation rather than ethnic self-definition. In the case of Spain, this becomes especially obvious. According to Strabo (*3*.1.6), the territory of Turdetania was inhabited by both Turduli and Turdetani. Turdetani are normally considered as the successors of the culture of Tartessos and the Turduli as their most Celtic-oriented branch, yet their ethnic association remains unclear (Bendala Galán 1998, 217).

Another problem is presented by an area mentioned in the written sources as Beturia (Strabo 3.2.3). The territory is normally considered to have been within the limits of the area occupied by the Turduli which at the same time was divided between Celtic groups in the north and Turduli in the south (Jiménez 2008a, 75). Even more difficulties are presented by the so-called ‘Lybiophoenicians’. These communities have been considered responsible for the control over certain mints (see later chapters). The cultural influences that can be perceived in the coins produced by these mints are so varied that it has not yet been possible to establish the origin or origins of the peoples in charge of them (Jiménez 2014).

Understanding the processes involved in ethnicity formation and configuration is therefore a very problematic endeavour, especially when trying to understand ethnic identity from material culture, since material evidence alone is not a definitive indicator of identity formation (Gardner et al. 2013, 7). One of the most plausible ways to define ethnic construction is the identification of common criteria such as shared history, shared mythology or genealogy, common language, common ethnic name and shared social structures (Gardner et al. 2013, 7). Nevertheless, there are difficulties in the application of this approach itself since most of the criteria cannot necessarily be identified in all ethnic groups. This highlights the impossibility of ascribing ethnic identities to defined geographical areas, since ethnic attributes are far more variable than the labels established within geographical boundaries on a map.

It is easy to presume that the 'Iberian' peoples described above were not necessarily circumscribed by the regions from which they received their names. Equally, the conglomeration of heterogenous groups in a specific area should not determine the ethnic identity of the whole local community. Groups of Bastetani, Turdetani and Oretani could easily have cohabited in the same region and later shared their territory with Phoenicians, Carthaginians and Greeks without this necessarily having an impact on their ethnic identity. It could also be the case that all these peoples considered themselves as belonging to a big communal ethnic identity as well as several other superimposed local identities (Jiménez 2008a, 77).

Whereas Iberians are considered the indigenous inhabitants of the peninsula, these populations seem to have first arrived during the Bronze Age and cannot be considered entirely 'indigenous'. The first Iberian groups were migrant communities like those which came after them. 'Indigenousness' is an archaeological construct, just like 'culture' or 'identity' which only acquires meaning when applied as an assertion of primordial ethnicity. The archaeological record demonstrates that other communities came to the Peninsula from across the Mediterranean from the 8th century BCE. The term 'Phoenician' denotes communities from Tyre (Sur), Sidon (Saida), Byblos (Gubla) and Arados (Arwad), all located on the Levantine coast of modern Lebanon and Syria.[9]

Greek written sources tend to refer to these groups as either 'Sidones' or 'Phoinikes', although the group ethnonym was never used by these peoples themselves (Sommer 2010, 115). According to the classical sources, the Phoenicians who arrived on the Iberian Peninsula were Tyrian, something that may be reinforced by the archaeological evidence and the importance of the figure of Herakles in the settlement of Gadir, a god closely related to the city of Tyre (Aubet 2009). According to written sources, the Phoenicians were a commercial culture attracted to Spain by its richness in metals, minerals and new opportunities for commerce. The Phoenicians were well-known for being the traders of the Mediterranean in the period in which they were active and are described in the Hebrew Bible as 'merchants that behaved like princes' (Isaiah 23.8). As Sommer (2010) has pointed out, trade is inevitably a form of interaction and any kind of interaction produces structural changes in all the groups involved. Although this perspective does not fit with my understanding that not all cultural interaction leads to cultural change, cultural trade should be seen as a form of cultural interaction.

[9] The volume of works published on the Phoenician presence in the Iberian Peninsula is significantly large, the work by M. E. Aubet has been fundamental to our recent understanding of the Phoenician colonisation and the establishment of the Phoenician communities in the Peninsula (Aubet Semmler 1997, 2008 and 2009) other fundamental works include Aubet Semmler and Del Olmo 1986. For a more recent Mediterranean perspective see Quinn and Vella 2014; Quinn 2019.

In Sommer's (2019) view, processes of interaction in the Mediterranean shaped the cultural identities of both Phoenicians and the groups they had contact with. The influence of Phoenician communities in Spain has been related to the beginning of coin production in Hispania. The oldest coins found come from Greek and Phoenician colonies, and the first specimens minted after Roman conquest come from those cities in relation with Phoenician or Greek settlements (García-Bellido/Cruces Blázquez 2001a).

The Greek and Phoenician presence in Iberia has been the focus of many studies (e.g., Bierling 2022; Domínguez 2002; Delgado/Ferrer 2007; Jiménez 2008b; Aubet 2009). The first mentions of Phoenicians in Spain are in the classical sources always in relation to the Greek *koine*. Velleius Paterculus (1.2.3) narrates the foundation of Gadir (Cádiz) 80 years after the fall of Troy (dated around the 11th century BCE) or Strabo (3.5.5) who relates the desire of the Tyrians to establish a colony beyond the columns of Heracles. Archaeology does not attest Phoenician presence in the area at such an early date, however, the presence of oriental pottery in the Atlantic coast could indicate commercial contacts in earlier periods. The estuary of Huelva has been highlighted as one of the main early commercial centres iin the south of the peninsula. In this area, the archaeological remains denote mixed material culture, including indigenous materials together with imported goods. This sort of evidence demonstrates the first coexistence of indigenous groups with Phoenician communities. This will be an important fact to take into account when understanding the importance of Phoenician writing in the local populations (Herrera 2019, 35).

Archaeology attests to Phoenician occupation in Spain from the 8th century BCE onward. In this period, a large Phoenician diaspora established new settlements beyond the homeland, most of which followed the commercial routes already explored in the preceding period.[10] In Spain, Gadir became the most important Phoenician city of the peninsula, developing strong commercial activity from the beginning and becoming the radiation point for important cultural influences mostly related with the figure of Herakles-Melkart. 19th century scholarship considered the Phoenician presence in Spain to be characterised by the establishment of small port settlements, normally situated close to river estuaries, with important centres being Malaka, Sexs, Abdera and Baria. Nevertheless, current archaeological scholarship is revealing a much larger Phoenician presence than first thought and the presence of Phoenician peoples far beyond the hinterland of the coast colonies in places like Castulo and in the inland of the province. In this context, Phoenician communities seem to have had a strong influence on the funerary rites of the province (Jiménez Diéz 2008).

Current excavations in Phoenician settlements have noted the continuity of these towns after the Carthaginian and Roman conquests and their transformation into centres of cohabitation for the very different groups who shared the territory (Jiménez 2008b). The coexistence of indigenous and Phoenician people is especially significant in the bay of Huelva and the Castillo de Doña Blanca near Cádiz. In these settlements, the material culture attests to the prevalence of Phoenician pottery combined with indigenous elements (Padilla Monge 2016).

In a similar chronology to that of the Phoenicians, the Greek presence in Spain has been subject of much research. Fundamental works in this context include a huge study carried

[10] At this time, other colonies such as Utica and Carthage in Africa, Mozia in Sicily, Sulcis in Sardinia and Lixus on the Atlantic coast of Morocco were also founded.

out by Rouillard in 1991. The volume deals with the complex issue of colonial interaction between the Greeks and other indigenous societies in the peninsula in two main periods. In the first (8^{th}-7^{th} centuries BCE), Greek interaction is considered sporadic and mainly focused on ship-based trade on the Andalusian coasts, whereas in the second period (ealry 6^{th} century BCE), the first Greek colonies were established by the Phoceans on the north-west coast.

The work by Rouillard (1991) considers the Greek presence in the peninsula (especially in the second period) as 'colonial' in nature. However, the colonial character of the Greek presence in Spain has recently been challenged (Domínguez 2002). Traditional views on colonialism tended to stress the cultural dominance of the colonizers and the existence of asymmetrical socioeconomic relationships among the different groups (Van Dommelen 1997). In the case of Spain, the ancient city of Emporion (Ampurias) in the north-east, was the most powerful centre of Hellenistic influence on the peninsula. Nevertheless, the cultural influence exerted by the Greeks and the economic contact with indigenous populations also reached the southern regions of the peninsula where the Greeks collaborated with native communities to establish long-standing cultural and economic relationships which later manifested themselves in the development of Graeco-Iberian script, the spread of new Hellenised influences and a well-structured economic network (Domínguez 2002). Nevertheless, the economic relationships between Greeks and indigenous communities in Spain have never been considered as an example of asymmetrical dominance and territorial control over the Iberian Peninsula was clearly not a main Greek objective. According to Dominguez (2002), this is because the Greeks developed a form of colonialism in Spain which was not characterised by the foundation of colonies nor the territorial or economic control over the population. Instead, it relied on a system of stimulation and satisfaction of elite needs within indigenous communities.

Regarding syncretism between Phoenicians and Greeks and its expansion across the Mediterranean, Irad Malkin's (2005) interpretation of the blending of the cult of Melqart with Herakles in Phoenician settlements is especially interesting because of its effects in the cultural dynamics of the area. Malkin considers this syncretism a means of mediation between indigenous and colonizing groups in the new colonies. In her view, cultural borrowings between Phoenicians and Greeks soon moved from specific site-based syncretism to generate a network of cultural influence that traversed the ancient *mare nostrum*. A good example of this can be seen in the figure of Melqart/Herakles, a god of great importance in Ulterior-Baetica and especially in the Tyrian foundation of Gadir. The worship of the god would have arrived in Spain through Tyrian colonizers who constructed the famous temple dedicated to the god which later became a centre of the cult (Malkin 2005).

Iconography related to Melqart/Herakles remains a constant from the first issues by the mint of Cádiz together with other cities dating back to the 3rd century BCE. Malkin underlines the appropriation of gods and heroic figures as a way to connect the city with mythic origins and become part of a Panhellenic network of settlements established across the Mediterranean. This exemplifies a practice of conscious cultural borrowing understood as a way to allow and stimulate commercial and cultural connections (Malkin 2005) that nicely interlinks with Dominguez's (2002) ideas on the 'irradiation' of cultural influences from the Greeks.

Related to the first colonial presences in Spain and their influence in the later centuries, Beltrán Lloris wrote a paper in 2015 titled 'Acerca del concepto de Romanización' for *Anejos del Archivo Español de Arqueología*. The piece addressed the discussion on the use of the term Romanisation, stressing especially the value of the term to denote the cultural transformations occurred in the first centuries of Roman control. Furthermore, the author underlined the little attention paid to the cultural transformations in the first centuries of Roman control (2^{nd}-1^{st} century BCE), especially by non-Spanish scholars. Some examples put forward to defend this standpoint were Merryweather and Prag (2002, 8) in their assurance that 'Romanisation (understood as cultural change) did not take place in the West before the C1 BC', and some years later, again Prag's (2013, 321; 344; 32-338) affirmation that the origin of the western epigraphic cultures was not entirely related to the Roman epigraphic habit. In his view, this related more to the increase in Mediterranean connectivity and the development of a Mediterranean/Hellenistic *koine.* In Beltran's view, although the degree of socio-cultural transformations experienced by these societies was less pronounced than those that occurred in the Augustan period, they should not be disregarded. The problem is the scale of comparison employed to understand such changes (Beltrán Lloris 2015, 22).

The second aim of the author was to stress the role of Roman influence in cultural change in the earliest centuries of Roman rule and the value of the concept for understanding phenomena such as the development of the epigraphic culture. To justify this perspective, Beltrán focuses mainly on the relevance of Roman influence to the development of the epigraphic habit especially in examples such as the *tesserae hospitales,* a Celtiberian manifestation of epigraphic practice that can only be understood within the Roman social institution of the *hospitium*.[11] The writing of these tesserae only occurs in interior areas of the peninsula and always between Celtiberian and Roman groups. Therefore, in the author's view, it is impossible to deny the Roman origins of these cultural manifestations (Beltrán 2015, 23).

Although Beltrán's position is justified especially in the development of the epigraphic habit, the role that non-Roman communities played in other aspects of cultural transformation cannot be ignored. For example, the numismatic record of the province, far from showing a Romano-centric perspective, displays a strong Phoeno-Punic influence in elements such as language, weight and iconography. The languages employed in the legends of the coins include Phoenician, Punic and Neo-Punic together with oriental iconographic types that display a strong diffusion of typically Levantine images such as Herakles-Melqart or Astarte-Tannit that maintained its prominence until well into the 1st century BCE.

Traditional research into Ulterior-Baetica has often been dominated by the notions that Rome played the main role in the transmission of 'civilisation' and that the pre-Roman substratum was 'unified' under a majority Iberian component (Bendala Galán 2005). Authors within this tradition inherited a vision of Roman influence as something that merged with an Iberian component but was different from Phoenician, Carthaginian and Punic-African traditions. García y Bellido was one scholar with this view: 'the only ones who left a deep and indelible imprint, the only ones who got to radically transform the

[11] The *hospitium* was a social institution in Roman law by which members of different communities could interact in a beneficial way to all the parties involved.

pre-existing cultural, economic and spiritual conditions of the indigenous peoples' life, were, as it is well known, the Romans' (1954, my trans).

Recent analysis of the evidence has shown this vision to be overly restrictive and undervaluing the significance of the Greek, Phoenician and Punic component in the cultural interplay of the province. As a response to this, much attention is currently being paid, not just to the interaction between Iberians and Romans but also contact between the different communities in the territory themselves (e.g., Domínguez Pérez 2005). The nature of these is fundamental to understanding how the colonial encounter with Roman groups impacted on the cultural ecosystem of the area, and how the different dialogues were established among all the communities of the territory. The exchange of all these cultural traditions gave rise to a multi-ethnic environment where cultures where entangled with one another.

3.2. Latinisation, bilingualism and multilingualism

The significant number of inscriptions preserved in Hispania have made the study of the epigraphic record of the province one of the strongest disciplines in Spanish scholarship. Within this field, two complementary schools can be noted. First, studies focused on the expansion of Latin over the indigenous communities ('Latinisation') and, second, studies of the Paleohispanic languages. This latter school started in the early 20th century with figures such as M. Gomez Moreno (decipherer of the Iberian script) and J. Unternmann, author of the well-known *Monumenta Linguarum Hispanicarum* (1975). Particularly important are a number of papers published by Siles, Mariner and de Hoz in the journal Paleohispánica from 2001 and volumes entitled *Historia lingüística de la peninsula Ibérica* published by Javier de Hoz in 2010 and 2011. However, it has not been until the last two decades that linguistic contacts between Latin and Paleohispanic languages have started to receive major attention. The publication by Adams of *Bilingualism and the Latin Language* in 2003 was a turning point for studies of the contact of languages in antiquity. *Contacts Linguistics dan's L'Occident Mediterraneen Antigue* edited by Ruiz-Darasse and Luján in 2011 and *Multilingualism in the Graeco-Roman Worlds* edited by Mullen and James in 2012 were only possible on the basis of Adams' work.

On the question of the spread of Latin over the peninsula, German Burgos (2006) and Beltrán Lloris (2016) have tried to understand the role that Latin played in the assimilation of Roman cultural traits and whether this had a direct impact on the disappearance of vernacular languages. In this context, Beltrán Lloris (2016) establishes connections between the use of Latin and different socio-cultural factors. In his view, Latin was perceived as a vehicle for demonstrating social, economic and cultural status and therefore its use in public and private contexts may have been motivated by reasons such as efficacy of communication with the gods (in the case of religious inscriptions) or a desire to show a link to a specific community (Roman or indigenous) (Beltrán Lloris 2016). Lomas' (2013) study of the Italian peninsula demonstrates the use of languages in the 3rd century BCE as a choice that depended upon different aspects such as context, audience, social background and status. If we export this hypothesis to Ulterior-Baetica, the use of Latin may have resulted from a globalizing tendency which enabled contact between the different communities who operated in the territory and allowed for a quicker spread of colonial cultural habits.

Nevertheless, the persistence of pre-Roman languages in the same spaces and at the same time as Latin differentiates 'language' as a complex identity indicator (Lomas 2013, 73).

Associating language with culture has been a common tendency in ethnicity studies, particularly following the development of European nation states in the 19th century (Gardner et al. 2013). It is common practice in archaeological and epigraphical studies to associate certain languages with certain geographies and groups. This practice can be traced back to Roman geographers and travellers who would define ethnic configurations in relation to the different languages spoken in the different areas (Gardner et al. 2013). If we extrapolate this concept to the modern world, what do we really mean when we refer to a certain group of people as 'Spanish' or 'English'? In both cases, these languages are spoken in several and very different countries; therefore, they cannot reflect specific geographical boundaries but cultural similarities and communal identity configurations. Similar problems occur when examining the languages spoken in antiquity.

The spread of Latin over the Iberian Peninsula and its configuration as a vehicular language caused the appearance of different materials and techniques to satisfy the demand for public and private inscriptions, a theme that has been well-adressed by Stylow (2001). The development of epigraphic culture has been discussed in relation the presence of '*instrumenta scriptoria'*. The *instrumenta* were tools used to make the inscriptions on the peninsula, and their presence in certain areas has been considered as evidence for the epigraphic habit (Alonso et al. 2012; Simón Cornago 2016). Although, in Hispania, these instruments have been related to literacy, they have not yet been associated with the phenomenon of Latinisation. Investigations are still in a very early phase and it has not yet been possible to establish a clear geography of the writing workshops in Ulterior-Baetica (Alonso et al., 2012). Research carried out in recent years, has demonstrated the use of *instrumenta scriptoria* in Iberian oppida that consisted of indigenous populations (Oriol Olesti forthcoming). This discovery has raised interesting questions regarding the origin of the epigraphic habit, its extension, as well as its connections with distributions of non-monumental texts, most of which remain still unexplored.

In contrast, literacy on the Iberian Peninsula has been identified well before Roman conquest in the broad range of local languages attested epigraphically in the territory. These have been classified into a) colonial languages, including Phoenician, Greek, Punic and Latin, b) indigenous Indo-European languages such as Celtiberian and Lusitanian and c) indigenous non-Indo-European languages such as Iberian and Aquitanian, to which one should add more than five different writing systems.

Paleohispanic scripts from the Iberian Peninsula have been divided into two main groups, northern and southern. Whereas the northern scripts have been almost fully deciphered, the southern scripts are still in the process of being decoded. Nonetheless, all of them seem to consist of a similar corpus of signs as well as structurally characteristic features such as the coexistence of alphabetical and syllabic characters. The similarities between them suggest a common provenance with its roots in the Phoenician alphabet (Moncunill 2019). In recent decades, the study of the epigraphic record of Paleohispanic languages — stimulated by the discovery of some extraordinarily important new inscriptions — has led to a significant advancement in knowledge of the cultural background of the indigenous inhabitants of the peninsula as well as the form and function of their languages (Moncunill 2013).

In the south of the Iberian Peninsula, two groups of languages can be differentiated: the colonial languages consisting of Phoenician (later influenced by Punic), Greek and Latin, and the indigenous languages consisting of the so-called ‘script of the southwest’, the southern script and 'south-eastern' Iberian. The scarcity of Phoenician inscriptions in this region is striking if one considers the strong presence of these communities in the archaeological record. Nevertheless, as Herrera Rando (2019, 44) stresses, the supposed scarcity is not that relevant when compared with other Mediterranean areas of strong Phoenician presence. The number of Phoeno-Punic inscriptions found in Spain and Portugal ranges between 150-200, which is not that far from the 300 inscriptions found in Lebanon, the Phoenician homeland. In Carthage, the number is much more significant but most of them are votive *stelae* from the Tophet, a sacred burial area (Herrera Rando 2019, 44).

Hispano-Phoenician epigraphic culture is characterised by a lack of stone-based epigraphy. Rather, the earliest examples of epigraphy, those found in the area of Cádiz, are normally property graffiti and *ostraca* and have been dated to the 8th century BCE (Herrera 2019, 42). From the 6th century BCE new influences arrive from Carthage and Hispano-Phoenician epigraphy starts to adapt to Punic spelling. The best-known example from this period is the Punic stele from Baria (Villaricos, Almería) generally dated to the 4th century BCE. From the 3rd century BCE onward, the influence of Carthage is very apparent, especially after the Second Punic War when minting activity in the Phoeno-Punic cities begins. The epigraphic record does not show significant changes, however.

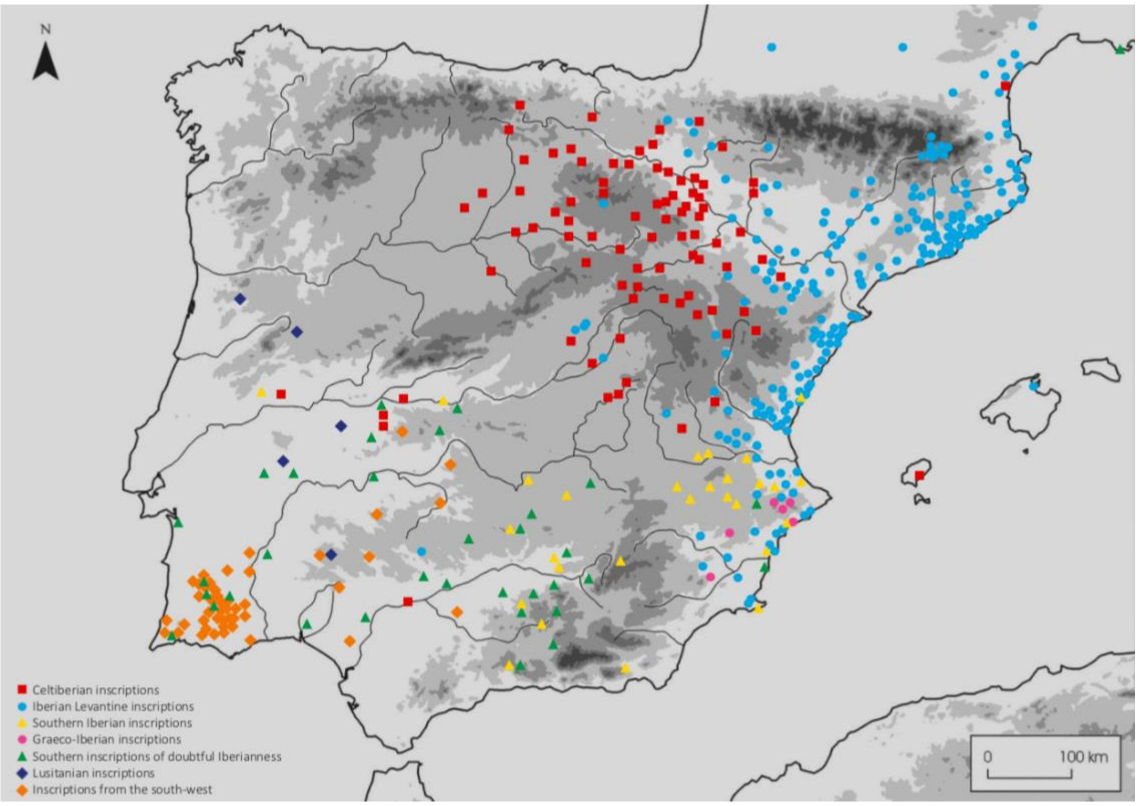


Fig. 3.1. Findspots of Paleohispanic inscriptions. (Source: Moncunill/Velaza 2016, 2). Reproduced courtesy of Noemí Moncunill and Javier Velaza.

The south-west script, also historically known as Tartessian or Southwestern Iberian, was originally found in a series of tombstones discovered in the 18th century (represented in orange in Fig. 3.1). Most of them come from the south-west area, the Algarve and Alentejo (Portugal). These *stelae* are normally dated between the 8th and 5th centuries BCE (de Hoz 2011, 359). The writing is from right to left and its disposition within the *stelae* is generally in the shape of a square spiral normally constituted by two parallel lines. Some of them also present figurative drawings of human figures holding shields and also accompanied by a chariot. Three *stelae* have been found in Andalucía one in Córdoba and two in Seville (Fig 3.2.)

Fig. 3.2. South-west stelae J.51.1, J.52.2 and J.53.1. (Source: Koch 2009). Reproduced courtesy of John Koch.

This language is no longer considered Iberian but a non-Indo-European variation. J. T. Koch (2009b) approached these texts from a Celtic perspective. However, there is still no definitive agreement on a possible Celtic origin of the south-western language and his hypothesis was very controversial. Together with the south-west *stelae*, one of the most important discoveries for understanding of the writing learning system in antiquity was the so-called ‘signario de Espanca’ (MLH IV, J.25.1) (Fig. 3.3) The two parallel texts recorded on the stone have been interpreted as an exercise in ‘writing learning’ in which the student tries to repeat the symbols recorded in the first line.

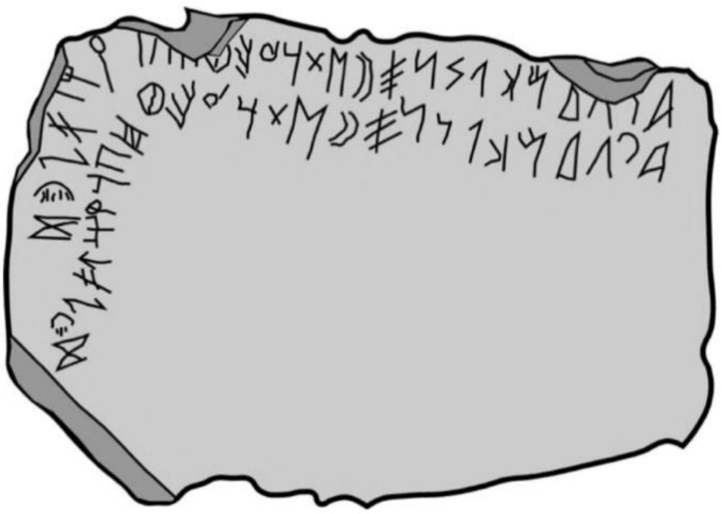


Fig. 3.3. 'Signario de Espanca' (Source: Koch 2009). Reproduced courtesy of John Koch.

Although controversial, and in a much later chronology (2nd century BCE), within the south-western script, one should also include the legend of the mint of Salacia (Alcocer do Sal, Portugal). The town was an important commercial centre involved in the sale and import of pottery and Hispano-Phoenician goods. During the first period, the mint produced bilingual coins with Latin script for the authorities and the south-west script for the toponym (**+beuibum)**. The iconographic types were, however, inspired by the city of Gadir (Cádiz) (see the tuna fishes in Fig.3.4.) and the metrology is close to the southern patterns as will be explained later.

Fig. 3.4. Coin from the mint of Salacia (MLH A.103.1)(Source: Hesperia, from the P.M.L collection).

From the 6th century BCE onward the south-west script started to disappear as it also occurred with the southern script, a writing that has been related with the Turdetanian culture. The funerary rites of these indigenous groups were characterised by cremation, which obviated the need for funerary *stelae*. The funerary traditions of the indigenous communities themselves characterised the cultural transformations of the period and the slow disappearance of funerary inscriptions (Herrera Rando 2019, 57). The so-called 'corpus of Southern inscriptions' has been dated 4th-1st centuries BCE and mainly consists of onomastic and toponymic testimonies (in green in Fig. 3.3). Although the script has not yet been completely deciphered, non-Iberian features such as consonant clusters and unrestricted *m* and *p* have been identified in some of the inscriptions (Simkin 2012, 81).

The sample is very diverse, with Indo-European and non-Indo-European names (including non-Iberian and Turdetanian anthroponyms). A very small number also seem to have a Phoenician origin. Those names that cannot be identified within the Latin, Iberian or Indo-European tradition have been identified as Turdetanian (Herrera Rando 2019, 60). These inscriptions are mostly located in the Guadalquivir Valley. The toponyms in the area seem to offer similar characteristics such as the repetition of **i(p)po** and **oba**, for example Baesipo (Barbate), Orippo (Torre de los Herberos), Basilippo (Cerro del Cinchi), Ostippo (Estepa) and many more (Herrera Rando 2019, 60).

Finally, the southern iberian ambit of Ulterior corresponds with the oriental part of the province. This area was initially part of Ulterior and later incorporated by Augustus into Tarraconensis. According to Strabo (3.4.12) the local groups belonged to the communities of Oretanians and Bastetanians. The archaeological record of the area attests to wheel-made pottery and also imports of Greek ceramics (Herrera Rando 2019). The visual production of the area is especially interesting with the sculptural groups of Obulco (Porcuna), as we shall see in the next section. In the funerary sphere, the tendency remains from the Orientalizing period of large chamber graves of one or several spaces. In the north-eastern area, the tomb of Toya is of special interest for its good state of preservation and the quality and quantity of material conserved. The tomb is located in the necropolis of Peal del Becerro, near to the Iberian *oppidum* of Puente Tablas and close to the Iberian town of Castulo (Fig. 3.5).

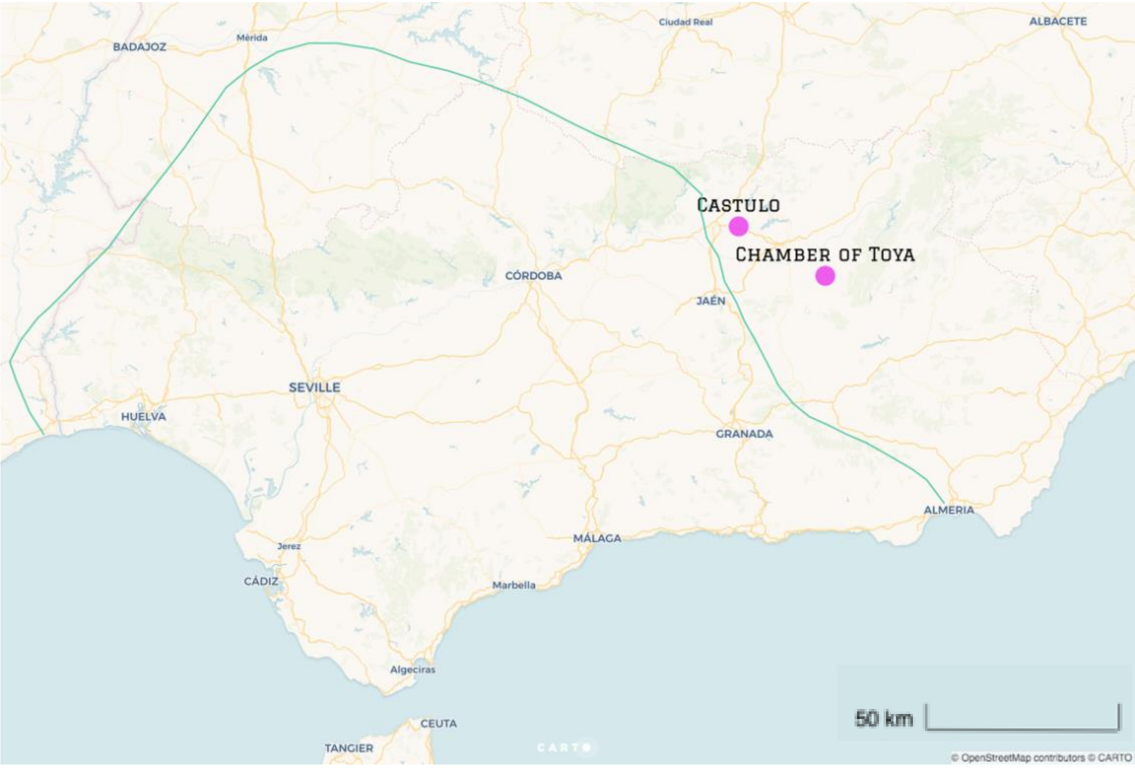
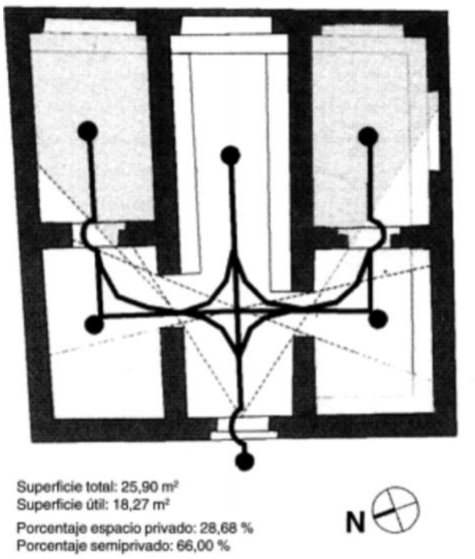


Fig. 3.5. Location of the tomb of Toya and Castulo outside the limits of Baetica after Augustus' reform.

The architectural structure of this sort of tomb has been traditionally related with Etruscans and Greeks, currently Phoeno-Punic influence seems the more plausible (Chapta et al., 1993). The tomb is dated to the first quarter of the 4th century BCE and has been seen as one of the most important remains of Iberian culture in the area. It has a square floor divided into four different spaces built with irregular ashlars embedded with each other without brackets or mortar. The chamber consists of one main rectangular room that can be accessed from the outside. On both sides of the entrance, two doors give access to two smaller square, lateral rooms that also give access to another two similar spaces (the deepest and darkest areas of the tomb: Fig. 3.6.a). Within the chamber, several pieces of Greek pottery were recovered (today in the National Archaeological Museum) as well as one small sculpture of an animal and several pieces of Iberian pottery (Madrigal 1997).

a) 

b) 

c) 
d) 

Fig. 3.6. a) Floorplan of the chamber (top left). Source: Madrigal 1997: 'Planta de la cámara de Toya con los análisis de circulacion y visibilidad (dibujo de J. Sánchez)'. *b)*

Greek red-figure crater (top right) (MAN catalogue 1918/54/1*). c) Limestone zoomorphic statue (bottom left) (MAN catalogue* 32621). *d) Iberian vase of the type 'cruz del negro'(MAN catalogue* 1986/149/8*). Source: Madrigal 1997. Reproduced courtesy of Antonio Madrigal.*

The toponymic record of the area ratifies the Iberian influence in the places' names in series constituted by **Ilti-** and **Iltu-** e.g., Iliturgi (Cerro Maquiz, Mengíbar), Iliturgicola (Cerro de las Cabezas, Fuente Tójar), Ilorci (close to Sierra de Cazorla), Ilubaria (close to La Guardia), Ilugo (Santisteban del Puerto), Ilurco (Cerro de los Infantes, Pinos Puente) and Iliberri (Granada) (Correa 2009, 289-290) Within the anthroponyms, examples of Iberian names have been identified in the region of Jaén (Herrera Rando 2019, 71). The epigraphic record of the Southern Iberian script starts with a graphite from Castulo (Cazlona, Jaén) dated to the 4th century BCE (Correa 2008, 281-282), and apart from other examples, it also includes a small graffito of difficult reading made on a sandstone sculpture of a horse's hock found in the necropolis of Cerillo Blano (Porcuna, Jaén). The sculptures of this set have been dated to the 5th century BCE, but the inscription is considered to be much later (Chapa et al. 2009).

Apart from the inscriptions on stone, other examples of this script are found in the legends of three different mints located in the eastern area of the province: Obulco/**ipolka** (Porcuna, Jaén), Iliberris/**iltúrir** (Granada) and the already-mentioned Castulo/**kaśtilo**. These will be explored further in the next section. However, precisely in the town of Castulo is where the only bilingual epigraph on stone conserved from the province was found. It is an opisthographic ashlar dated to the 1st century BCE (CIL II 3294). The text is recorded on a piece of local limestone with the measurements 62 x 88 x 17 cm. The stone has two different texts in indigenous language but recorded in Latin alphabet (Fig. 3.7).

Fig. 3.7. Bilingual inscription from Castulo (CIL II 3294). (Source: Moncunill/Velaza 2016, 12). Reproduced courtesy of Noemí Moncunill and Javier Velaza.

Bilingualism implies the coexistence of Latin and vernacular languages in the provinces before and after Roman conquest. Scholars such as Adams (2002; 2003; 2007) and Wallace-Hadrill (2008) have considered bilingualism in antiquity as a fundamental element to understand the connections between language and cultural identity. The study of bilingualism emerged as a field in the late 80s and early 90s. At that time, the focus was on elite bilingual output and Latin was considered to have had supremacy over other languages. Adams' work on bilingualism (2007) sheds new light on the study of multilingual inscriptions and helps spread knowledge of evidence coming from across the provinces. Following Adams' premises, Mullen and James' (2012) edited volume on *Multilingualism in the Graeco-Roman Worlds* has recently opened a new path towards the understanding of language contact in antiquity. The contribution by Simkin (2012), on the role of this phenomenon in Hispania, considers the Peninsula as a dynamic multilingual environment in which the interaction between indigenous languages themselves was fully influenced by the arrival of the Romans, generating complex multilingual situations involving all different linguistic systems.

Whereas linguistic contact between the different Paleohispanic languages has been demonstrated, it is a difficult endeavour to identify specific situations of multilingualism and even bilingualism in this context. In contrast to the views of Adams (2007) and Simkin (2012), Spanish scholars seem to have a rather sceptical perspective on the question. Among them, Velaza Frías has recently challenged Adams' vision of bilingualism in ancient Hispania, considering it 'disappointing and little convincing, based on outdated bibliography and alien to the approaches taken by current scholarship in the field' (2011, 89). The question is definitely complex and currently poses serious difficulties in achieving secure perspectives on whether the Iberian Peninsula could be considered as a multilingual environment in antiquity in which most of the population was able to communicate in several languages.

Even more complicated is drawing conclusions on dual identity on the basis of such scarce sources. In my opinion, multilingualism and or bilingualism did exist as linguistic phenomena in ancient Ulterior-Baetica although the epigraphic record does not necessarily reflect the oral tradition. Estarán Tolosa's work (2015) consists of a comprehensive analysis of the phenomenon of epigraphic bilingualism in the Roman west and presents the most updated collection of bilingual inscriptions in Hispania. Her work reaches three main conclusions: a) bilingual inscriptions were not a common phenomenon in antiquity, b) despite their scarcity, bilingual inscriptions tend to bear significant onomastic data, emphasizing especially Punic-Latin bilingual inscriptions and c) bilingual inscriptions in the Roman world relate directly to the vernacular literacy of the population.

With the aim of answering long-standing questions as well as trying to break through discipline limitations, sociolinguistic methodologies have recently been applied to the understanding of mixed-language inscriptions. Mullen's work (2012; 2013) relies on sociolinguistic models to understand multilingualism and identity performance in antiquity. Cutting across provincial, chronological and disciplinary boundaries in the Roman Empire, Mullen has brought language variation and multilingualism in the provinces back into the picture. In her work, language is considered a fundamental element in the expression of identity: therefore, sociolinguistic approaches can help in the deconstruction of the complexities of individual and societal identities in antiquity. Mullen echoes the recent interest in the phenomenon of code-switching[12] in contemporary studies (Callahan 2004) and challenges the application of code-switching to the field. According to the scholar, either written or spoken code-switching can respond to a carefully considered process to mark a deliberately made choice (Mullen 2013, 25). Mullen supports Adams' (2003) conclusions that linguistic code-switching is a phenomenon that obeys defined choices made with symbolic purposes, one of which could be the 'expression of identity, perception of self and belonging' (Mullen 2013, 25). Wallace-Hadrill's (2008) model of code switching provides a new framework for understanding material culture and the construction of mixed identities that trades replacement for continuity. Mullen (2013) supports this view but goes a step further by considering other phenomena like interference and borrowing. As of March 2020, Alexandra Mullen is the principal investigator of the *Latin Now* project[13], an endeavour founded by the European Research Council that aims to investigate linguistic processes

[12] Code switching happens when the speaker or interlocutor alternates between two or more languages in the communication of a message.
[13] https://latinnow.eu (accessed June 2020).

in the Western provinces during the advancement of Latin and to reflect upon when and why Latin overtook the former Iron-Age languages.

In conclusion, bilingualism and multilingualism can provide fundamental tools for the understanding for the further development of Cultural Contact theory. The phenomenon of linguistic influence from one community to another that can be perceived from the evidence has been identified as an ultimate sign of cultural interaction and cultural change. The multilingual paradigm can be employed as a deductive instrument to determine the type of contact situation perceived in the material evidence. In relation to this, the use of non-direct evidence has become a very profitable technique in the last ten years. Non-direct evidence is that which relies on an inference to demonstrate a hypothesis. In this case, there is no direct evidence for oral multilingualism in the peninsula, although the scarce epigraphic evidence and the attested trade contacts between the different communities suggests it was likely. Hence, statements such as these would be supported by the use of non-direct evidence in the form of what some scholars have defined as 'contact-induced phenomena' which are not necessarily linguistic but inevitably presuppose linguistic interaction. Current works are revealing the need for more multidisciplinary projects to achieve a holistic perspective on the evidence and a broader understanding of cross-cultural interaction processes, not just in the linguistic record of a community but also in all the possible sorts of material culture.

3.3. Coinage as an expression of collective identity

Coins are official documents, historical sources of a primary character that can provide a lot of information about the decisions behind their design, production spot and subsequent distribution by human intervention (Garcia Bellido/Cruces Blázquez 2001A). Centres of coin production in antiquity, i.e., mints, are relatively easy to locate geographically and chronologically due to all the information collected in the specimens. Because of its constant circulation and both its material and symbolic value, coinage has been considered as perhaps the most powerful vehicle for ideological discourse in antiquity (Noreña 2016).

The numismatic record of the Iberian Peninsula offers fundamental insights into the process of cultural interaction in Ulterior-Baetica. As noted above, the oldest coins preserved on the peninsula are of Greek and Phoenician origin. Nevertheless, most of them have been found in centres like Seville and other towns in the south of Spain. This has been considered as evidence for the earlier origin of these settlements and the coexistence of southern iberian groups and Greek and Phoenician settlers in Iberia (Garcia-Bellido/Cruces Blázquez 2001A). The contact between these groups must have promoted the practice of minting in local populations since the first cities to mint were those that remained in contact with Greek and Phoenician groups such as Gadir (Cádiz), the first mint in Ulterior-Baetica with issues from the 3rd century BCE.

Although the circulation of Punic coins in Hispania seems to go back to the 4th century BCE (Pliego Vázquez 2018), the arriva of the Carthaginians in 237 BCE stimulated the minting of Hispano-Carthaginian coins with simple iconographic patterns. As money became necessary to cover the expenses of the Second Punic War, the Barcids started to portray the faces of their generals on their coinage. The Carthaginians were mainly on the east coast of the peninsula; we can see their influence in mints that would later become part of Hispania Citerior. In contrast to other centres in the Mediterranean (e.g., Magna Grecia, Sicily or Carthage), where indigenous minting decreased after Roman arrival, in

Hispania (after a small decrease in the first years) minting grew until reaching its peak after the Second Punic War (170 BCE), when it has been estimated that around 69 workshops were in operation (Chaves Tristán 1989, 147).

Metrology is the field that studies the weights of coins and metals used in the minting. Unlike legends or iconography, the weights of the coins are one of the most invariable patterns in coinage, they are adopted by the communities in charge of the issue and it takes time for them to be changed or adapted to other values. The weight pattern generates the coin value, and from it, the monetary system that combines the weight pattern and the metal employed in the coinage. In Spain, the metrology of coins was as varied as the number of cultural systems that minted their own coins: Greek drachma, the tirian-sirian siclo (Turdetanian pattern), Carthaginian siclo (coined by the Barcid family), the Iberian drachma and the Roman pound (García Bellido/Cruces Blázquez 2001a, 79). In Spain, the fact that the weights of coins are difficult to change seems to be especially true since in some cases, the metrology goes back to the first commercial circuits and only changed after the reform of Augustus in the 1st century AD. García Bellido/Cruces Blázquez 2001a, divide the peninsula into four metrological areas:

- Greek area originated by Ampurias and Rhode with a pattern of 4,7 g. that could adapt easily to the Roman denarii of 4.5 g.
- Iberian area in the eastern coast (Valencia and Murcia) with a drachma of 3.0 g.
- The Celtiberian area characterised by the Iberian denarii created in the current area of Catalonia. The value chosen for the coin made in AE is 15.48 g.
- The Turdetanian area based in the Phoenician shekel of 9.4 g. introduced to the peninsula in the Tartessian times.

The unit of Gades (half shekel of 4.75) seems to have originated from the Turdetanian pattern which also influenced the mints of the southern coast with values around a quarter of a shekel. However, the influence of the Phoenician shekel can also be found in different types depending on the cultural influence of the area, ranging from the ½ shekel of Gades to the shekel of Carthage (7,60 g) and the shekel of the Hispano-Carthaginian coins (7.50 g) (García Bellido/Cruces Blázquez 2001a, 84). In any case, the area of Ulterior-Baetica is especially varied in this respect and it is particularly difficult and ineffective to establish a general pattern as most of the cities will have had different influences, as we shall see in the following chapters.

In terms of material, within the Mediterranean area, the tendency was for the states to choose a metal (generally gold or silver) to be the basis of their monetary system associated with another metal of lower value for the dividers (normally bronze or silver if gold was the main value). In the Iberian Peninsula, gold was first used by the Barcids in a small set of anepigraphic issues considered Hispano-Carthaginian because of their Spanish provenance (García Bellido/Cruces Blázquez 2001a, 73). After that, Augustus used the mints of Caesaragusta (Zaragoza) and Colonia Patricia (Córdoba) between 20 and 17 BCE probably to bear the *stipendia* for the wars in Cantabria and Germany as supported by the findings of Hispanic coins in that country (García Bellido/Cruces Blázquez 2001a, 73).

Silver was first used in Spain by the Greek colonies (Rhode and Emporion) from the 5th century BCE onward and always in low value coins for commercial purposes. Apart from that, there is evidence for the use of this metal in indigenous societies before the total development of coinage especially on the east coast, but the findings are very scarce

(Ripollés 2012). The greatest amount of minting in silver in the east of the peninsula was again carried out by the Barcids from 237 to 206 BCE in the so-called Hispano-Carthaginian mints. The metal for this probably came from the mints of Carthagonova and Castulo on the border with Hispania Ulterior. In Ulterior, Phoenician colonies used silver as the basis of their monetary systems (i.e., Malaca and Gades) before the Roman republic; by then, the only silver coin in the peninsula was the Iberian *denarius* with a weight of 4.0 g produced by the Celtiberians and other communities on the left side of the Ebro River in Tarraconensis.

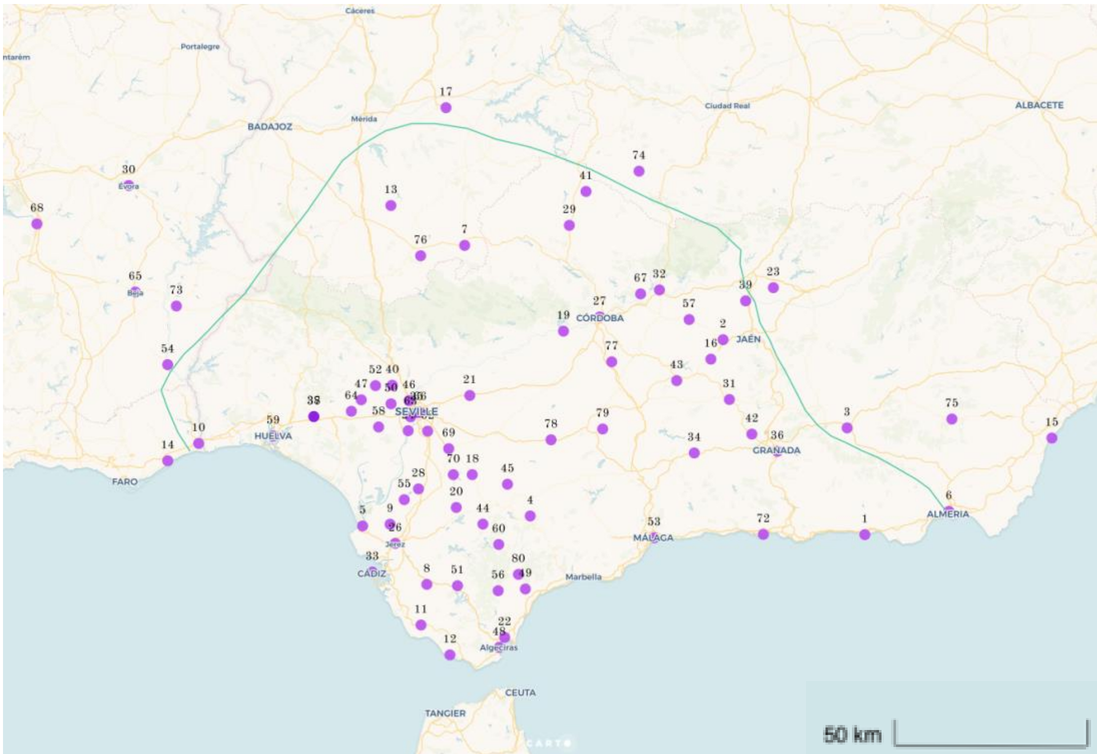
The third and most-used metal in the Iberian Peninsula was the copper-bronze (Ae), also known in Latin as *aes-aeris*, and introduced by the Carthaginians who certainly had an influence in the minting of copper issues in the first half of the 3rd century by Gades and Ebusus (Ibiza) (García Bellido/Cruces Blázquez 2001a, 75). During the Second Punic War, bronze started to be coined in Ulterior starting at Phoenician colonies like Malaka, but it is not until the time of the proconsul Cato (234-149 BCE) that ae were systematically coined in indigenous towns like Castulo and Obulco. From this time onwards, bronze became the only metal coined in Ulterior. The Romans in Hispania also coined *aes* and *ases* especially in late Republican times when Pompey and Caesar issued *denarii* in their name or in those of their lieutenants (Crawford 1992).[14]

Despite the restrictions in material, mints in Ulterior exercised total control regarding the iconography, the metrology and the legend. The immense diversity apparent in the coins of Ulterior-Baetica should be understood as evidence for the prevalence of the pre-Roman

[14] Fundamental to the study of Roman coinage in the peninsula is the work by Villaronga 2004 and Crawford 1992.

cultural milieu of the province until well into the 1st century BCE which at the same time should be seen as the result of nearly two centuries of cultural diversity and interaction.

Very well-studied are the fundamental differences between the coinage in the two provinces not just in the material but in all the other aspects of the minting. In Hispania Citerior, the monetary types were rather homogenous, preferring the depiction of a male head on the obverse and the horseman with spear on the reverse. The script used by the indigenous mints was always the ‘Levantine Iberian’. In Hispania Ulterior, however, as discussed, there was a much greater variety of iconographic types, languages and weights. From the 4th century BCE to the 1st century CE, in the area of Ulterior-Baetica, approximately 80 mints were active (Fig. 3.8).



1.Abdera	21.Carmo	41.Iltiraca	61.Oretum
2.Abra	22.Carteia	42.Ilurco	62.Orippo
3.Acci	23.Castulo	43.Ipora	63.Osset
4.Acinippo	24.Caura	44.Iptuci	64.Ostur
5.Aipora?	25.Celti	45.Irippo	65.Pax Iulia
6.Alba	26.Cerit	46.Italica	66.Romula
7.Arsa	27. Colonia Patricia	47.Ituci	67.Sacili

8.Asido	28.Cun(v)baria	48.Julia Traducta	68.Salacia
9.Asta	29.Detumo-sisipo?	49.Lacipo	69.Salpesa
10.Baesuri	30.Ebora	50.Laelia	70.Searo
11.Baicipo	31.Ebura-Cerealis?	51.Lascuta	71.Segobriga
12.Bailo	32.Epora	52.Lastigi	72.Sexs
13.Balleia	33.Gades	53.Malaca	73.Sirpense
14.Balsa	34.Halos	54.Mvrtili/Mirtiles	74.Sisapo
15.Baria	35.Hispalis	55.Nabrisa	75.Tagilit
16.Bora	36.Iliberri	56.Oba	76.Turris
17.Brutobriga	37.Ilipa Ilipense	57.Obulco/Ibolka	77.Ulia
18.Callet	38.Ilipla	58.Olontigi	78.Urso
19.Carbula	39.Iliturgi	59.Onuba	79.Ventipo
20.Carisa	40.Ise	60.Oquri	80.Vesci

Fig. 3.8. Map and list with distribution of mints in the province of Baetica and surrounding area.

Although much analysis is still needed, the question of iconography has been of significant interest to Spanish scholarship. When Ulterior-Baetica was configured, most of the cities had already had a colonial experience under Carthaginian power since Phoenician iconography prevails and, in some cases, Iberian motifs. Some patterns have been clearly identified and related to the cultural background of certain ethnic groups, such as the representation of Melqart/Herakles by coastal mints with strong Phoenician presence, (e.g., Gadir (Cádiz) and Malaka (Málaga)). Another example has been noted in the representations of female heads on the obverses from the first to the fourth series of the mints at Obulco (Fig. 3.9) and Abra. These well-coiffed women wearing buns and looking right have been understood as Iberian depictions of fertility goddesses normally in interaction with agricultural depictions of corn ears and other crops on the reverse with parallels in the mints at Carmo, Caura, Turrirecina and Malaka from the 3rd to the 1st century BCE (García-Bellido/Cruces Blázquez 2001b, 289).

Fig.3.9. Coin from the mint of Obulco series 3 type 5 (MLH A.100.2; Hesp A.100.2) (Source: Hesperia).

The mint of Obulco is especially revealing regarding its iconographic trajectory since this ‘Iberian goddess’ seems to give way in the last issues of the mint to Apollo-like male heads much more related to Hellenistic influences and which find parallels in Roman *denarii* from the 1st century BCE (Fig. 3.10. Garcia-Bellido/Cruces Blázquez 2001b, 289).

Fig. 3.10. Coin from the mint of Obulco with Apollo on the obverse (CNH 351,4) (Source: coinproject). Images reproduced courtesy of Jesus Vico S.A.

The mints of Arsa (Azuaga, Badajoz), Asido (Medina Sidonia, Cádiz), B’ B’ L? (Mesas de Hasta, Cádiz), Bailo (Baelo Claudia, Bolonia, Cádiz), Iptuci (Prado del Rey, Cádiz), Lascuta (Mesa de Ortega, Alcalá de los Gazules, Cádiz), Oba (Jimena de la Frontera, Cádiz) Turirecina (Reina, Badajoz) and Vesci (Gaucín?, Málaga) have traditionally been included in the 'Lybiophoenician' group. These mints received this name from Zobel because of the impossibility of understanding the language in their legends. They were produced in late periods, even after Roman conquest, and show the fundamental influence that indigenous and Punic magistrates/authorities must have exerted on the coinage. This group of mints is therefore a good example of how different cultural influences can interact together in one single object and should be considered as an example of cultural contact in the peninsula. The coins display what seems to be Turdetanian language written in a non-deciphered script (considered 'Lybiophoenician' by current scholarship) together with typically Punic motives. Furthermore, the mints were active during both the pre-Roman and Roman periods and were established in different cities mostly but not only in the hinterland of Cádiz.

Nevertheless, the importance of these pieces has somehow been neglected in traditional scholarship. García Moreno (2001), for instance, has pointed out how anti-Semitism may have impeded deeper insight into specimens like these. They can however shed much light on the diversity of cultural influences at the time, depicting a landscape which is far away from the Ibero-Roman models promoted in the 19th century. Further recent works in the mints include Estarán-Tolosa's analysis of bilingualism in legends (2016) and a recent study by Jiménez (2014) on the potential Punic origins of the mints.

To understand the cultural variation presented by the mints on the peninsula Chaves Tristán (2008) developed a model for the dissemination of new iconography and patterns in local coinage. Her model theorizes three different responses of local elites towards the new cultural dynamics: first, emulation, meaning the endorsement of the indigenous essence of the community and its local imprint by the emulation of the minting habit of the colonial groups; second, imitation, meaning approximation towards Roman and Italic forms such as the insertion of Roman magistrates' names (e.g., Abra, Acinipo, Bailo, Castulo); and finally, integration, which presupposes the total assumption of Roman models and the progressive rejection of local patterns (e.g., Italica, Colonia Patricia). The latter seems a logical phenomenon to expect given that they were Italic and Roman colonies on indigenous land. However, Chaves Tristán does not provide examples of cities for each of the responses that conform to her model. Furthermore, her theory explains the minting habit in direct relation to Rome, overlooking other possible influences such as the Phoenician or Greek as well as more complex phenomena such as those observable in the so-called Lybiophoenician mints.

Although some of the iconographic types persist in the oldest settlements, Chaves Tristán (2008) has noted a desire for differentiation in the new mints that emerged in Ulterior during the 2nd century BCE seen in the iconography but also in the text recorded on the legends, either in the alphabet or in the names. The epigraphy of the coins provides a lot of information about the minting authority (e.g., the name of the magistrate, the magistracy or the number of authorities) and the decisions behind the choice of language. In comparison with the epigraphic record of Hispania, coin legends have been a slightly neglected field probably because of the incredible amount of data that still needs to be systematised. In the same way as public inscriptions, Latin starts to spread into coin legends after Roman conquest. Coin legends in Ulterior-Baetica record: a) toponym, b) authorities (personal names or magistracy), c) administrative formulas and d) community names. All of these were expressed in one or two languages according to the community desire to depict an individual or a shared identity.

During the Republican period, five different scripts are recorded in the mints of Ulterior-Baetica: Latin, Iberian, Lybiophoenician, Phoenician and Neo-Punic. This classification has been recently expanded to differentiate between Phoenician (e.g., Gades) and Punic (e.g., Malaka) and between Southern Iberian e.g., (Obulco) and South-western script (e.g., Salacia). As we have seen before, minting arrived in Hispania via the Greeks in Emporion and Phoenicians in Gadir (Cádiz) and Arse (Sagunto, Valencia), the main centres with significant coinage before the Second Punic War. However, is not until the 3rd century BCE that the vast majority of cities in Ulterior-Baetica start to develop this practice. Minting in Ulterior-Baetica has two main foci of influence: on the one hand, Gadir with its own iconographic language characterised by Herakles and tuna fish, and the use of the Phoenician alphabet paralleled by 'Punic' mints such as Abdera (Adra, Almería) and Sexs (Almuñécar, Granada) (Alfaro Asins 1986; 1996); and, in the indigenous domain, Obulco (Porcuna, Jaén) and Castulo (Linares, Jaén) characterised by the effigy of the female head with a bun and the use of the Southern Iberian language.

There are four different combinations of languages in the bilingual coins of Ulterior-Baetica: Latin-Iberian, Latin-Punic, Latin-Neo-Punic and Latin-Lybiophoenician. Latin appears in combination with one or other of the vernacular languages of the peninsula and these never appear mixed together. This tells us a lot about the sort of cultural interaction between the different communities perhaps stronger itself after Roman conquest. However, it could also be one of the reasons why the Roman-local interaction has received more interest than contacts between other communities. Nevertheless, although there is no epigraphic interaction between the different languages, there is a significant exchange of iconographic patterns: we see Phoenician foundations such as

Abdera depicting Punic iconography or mints with exclusively Latin legends such as Aipora, that display strong Phoenician influences (see Garcia-Bellido and Cruces Blázquez 2001a).

Whereas all the mints within the Punic sphere included Latin legends (normally the toponym) from the 1st century BCE – excluding Malaka, which continues with Phoenician until the end of minting – it is striking however that Abdera (Abra), Sexs (Almuñécar) and Ebusus (Ibiza) still use Punic legends until the late empire even when all the mints in Ulterior were already Latinised. This implies a strong level of autonomy and independence from Rome which has also been understood as a result of the political autonomy of these cities as well as their economic necessities, since most of them had important trade relationships with Punic enclaves in the north of Africa as attested by the Punic metrology of the coins (Estarán 2012).

The introduction of Latin by cities with Punic influence has been related to the presence of Italic elites such as for example at Carmona. Despite being considered a Roman town (Caballos Rufino 2001), Bendala Galán (2001, 39) and others have underlined the importance of the Punic influence in the city of 'Carmo' during the Barcid[15] period when Carmona was monumentally and military enhanced. The well-known necropolis of 'El

[15] The Barcid family was one of the leading dynasties in Carthage. They fought against the Roman Republic in the Punic Wars to defend their mercantile power in the Mediterranean. In Spain, they founded several colonies including Arse (Sagunto, Valencia) and Cart Hadast (Cartagena, Murcia). Hamilcar Barca (275–228 BCE) and his sons Hannibal (247–182 BCE) and Hasdrubal (245–207 BCE) defended the Carthaginian cities in Hispania. This family had a fundamental influence in the cultural setup of southern Spain at the time. Ivan Negeruela has recently claimed the discovery of the sumptuous palace of Hannibal, in el Cerro del Molinete (Cartagena) which is mentioned in ancient written sources as a unique monument (Pol.10.10.8) (Negeruela, 2015). Very little is known about the cultural impact of the Barcids in South-Eastern Spain, and the effect that these influences had in the later contact with Roman groups. Further research is needed in this area especially in the light of the latest studies, which reveal a significant presence of the Phoeno-Punic element.

Elefante' in Carmona was highlighted by Bendala Galán because of the importance of the Phoeno-Punic element, considering it 'neo-Punic' rather than pre-Roman (Bendala Galán 2001, 38). This categorisation emphasises the Punic element in the area which had an important influence in the substratum of the city. Whereas the coins of Carmona show Punic elements especially in the iconography, the town never minted coins with legends in other language than Latin (Garcia-Bellido/Cruces Blázquez 2001a, 37).

On the coast and in the south of the province, there seems to be a larger number of cities that minted coins with Phoeno-Punic iconography and metrology such as Abdera, Sexs, Gadir, Traducta, Baria or Oba. Nevertheless, in the Guadalquivir Valley the number of towns that minted coins with Punic influence either in the iconography or the metrology is also striking, posing the question of whether the Punic influence in these cities was stronger than previously thought or whether this attests to a Phoeno-Punic *koine* in the area.

The town of Obulco only minted coins with Latin legends in its first series. After that, it was the first mint to introduce the indigenous version of the toponym in Southern Iberian script together with the Latin version. The tendency in western mints was normally the substitution of indigenous languages with Latin that is progressively imposed. Obulco however broke with this tendency since it started minting in Latin, to later use the indigenous language and then go back again to Latin. This has been understood as a manoeuvre to demonstrate closeness to Roman administration by using the colonial language on the coins of the first years to then go back to the indigenous language once the relationship between the town and the Roman authorities improved (Chaves Tristán

2000, 122). This is a rather simplistic explanation, however, that neglects the social and cultural aspects of this particular phenomenon.

The language of the legend of coins in Hispania has traditionally been taken as one of the main justifications to ascribe the specimens to a specific culture and, within it, to specific ethnic groups (Garcia-Bellido/Cruces Blázquez 2001a, 35). Nevertheless, it is well-known that languages are one of the main factors that can participate in and result from cultural exchanges and do not necessarily imply ethnic association. As discussed, several languages have been epigraphically attested in Ulterior-Baetica before Roman conquest. Nevertheless, Ulterior-Baetica is the province in which Latin more rapidly became a vehicular language (Herrera 2019). This is reflected in the epigraphic habit but also in the numismatic record. We know that different groups used vernacular languages to communicate between themselves and establish economic relationships with others; nevertheless, not all the languages are considered to have had similar levels of prominence. Punic has been considered the working language in the territory that would later be substituted by Latin (Garcia-Bellido/Cruces Blázquez 2001a, 35). There are examples of mints that soon introduced legends with the toponym written in Latin, but which maintained Punic iconography and metrology. If we consider all the mints that incorporate Punic legends in their minting to habe been run by Punic communities, it could be said the Punic groups were still functioning in Ulterior-Baetica during the 1st century BCE (two centuries after Roman conquest), especially in the western area of the province, which has the most prominent collection of Phoenician and Punic archaeological remains.

The existence of such a large number of 'Punic' mints has led scholars to consider whether there was a Phoeno-Punic *koine* in the area that triggered the use and acceptance of this alphabet by communities whose ethnicity was not necessarily any of the two (Garcia-Bellido/Cruces Blázquez 2001a, 37). This, in my view, should be seen as an example of cultural contact. Here we see how cultural interaction, among the different communities, triggers the adoption of linguistic, iconographic and epigraphic patterns that are alien to the community but that acquire a meaning after cultural exchange and which at the same time become a vehicle for this new cultural understanding.

Coins help us to consider how cultural change can be perceived in an object. When the Roman and Italic groups arrived in Spain, the Roman republic was itself under a process of monetisation, and the minting habit and the production of coins in Ulterior-Baetica was probably developed in a situation of reciprocal influence between the indigenous and the colonial groups (Chaves Tristán 2008, 353). After Roman conquest, and within a time lapse of two centuries, the cultural behaviour of the indigenous communities showed complex changes. At the same time, Roman 'culture' and everything that it implies probably integrated a series of new cultural traits as the result of the dynamism experienced on the peninsula at this time, which was catalyzed by the indigenous populations together with the influence of external agents (Roldán-Wulff 2002, 417, 465). As we shall see later, the freedom of local mints in Ulterior Baetica to depict local traditions and imagery is striking. This situation can be compared with other mints in eastern territories such as Antioch, where Rome bestowed the honour on selected cities to mint coins with local heritage images but including an image of the emperor on the obverse. Other provinces such as Gaul never received those permissions. It would be interesting to consider why the case of Ulterior-Baetica is different.

3.4. Meaning and the visual arts

The study of sculptural production in Hispania does not seem to have major significance in Spanish archaeological scholarship. It is difficult to find archaeological records of specific excavations that also provide meticulous descriptions of the sculptures or paintings found on site, let alone the cultural influences that can be traced in them. Reports tend to be included in specific monographs about visual arts or conceptual papers that try to reinforce a theoretical model using some of these pieces as an example to illustrate a theory. This creates a landscape of isolation in which the studies of the numismatic, visual and epigraphic record of specific sites are discipline-focused and very seldom put in relation with each other. Nonetheless, statues and other pieces of visual art are frequently found in excavations and they can provide a great deal of information about the cultural milieu of the site in question. Furthermore, the study of the sculptural record of the peninsula has traditionally been more concerned with the cataloguing and systematisation of the large number of objects found in excavations rather than deeper analysis of the cultural significance of the pieces.

In addition to this, and in clear contrast with other fields such as Paleohispanic studies, there is not a specific discipline dedicated to the study of pre-Roman sculpture on the peninsula. In fact, has been little systematic work on the whole body of sculpture on the Iberian Peninsula before Roman conquest that includes all the objects produced from the Phoenician era to the Republican period. Instead, there seem to be parallel schools of study that focus on the sculptural production of specific periods or cultures such as the Iberian culture or the Republican period but neglecting a general analysis of the sculptural record in its totality. I suggest developing a general study of pre-Roman sculpture in the peninsula as it is already occurring in other disciplines like Paleohispanic studies. This approach would allow a much more comprehensive study of the progressive changes in the visual arts from the Iron Age to the end of the Roman era and would help to understand how cultural contact between different groups is reflected in the changes of the sculptural record of each of the provinces. Furthermore, the application of LOD technologies to current and future databases developed ad hoc for this purpose would provide standardised access to the evidence and would facilitate therefore the cross-querying of different digital repositories.

As above with the epigraphic and numismatic record, the following section consists of a brief overview of the sculptural production of the province before Roman conquest, including some of the best-known and best-conserved pieces. This overview is fundamental to understanding the sculptural evidence conserved from the communities in the area and relating it to the wider evidence collected in the database.

The sculptural output of Ulterior-Baetica has been related to different cultural influences, including Egyptian, Phoenician, Punic, Greek, Iberian and Roman. The materials range from different stones to metals, always from the local area. The pieces are associated with the funerary and ritual spheres and very rarely with the private sphere. The production normally attributed to Phoenician artisans is generally of small size made in local materials such as terracotta and bronze and tends to be related to or represent the prototypical Phoenician gods Astarte-Tannit and Herakles-Melqart. Within bronze production, one of the most widely studied pieces is the Bronze Carriazo (ca. 5th century BCE). It was probably part of a brooch and represents the goddess Astarte with the hairstyle of Hathor, the Egyptian deity, wearing a short tunic decorated with lilies and flanked by two ducks. The bronze appeared in Seville and has been related to the civilisation of Tartessos[16] (Jiménez Ávila 2002, 411). Also related to the world of Tartessos, is the so-called Astarte of the Carambolo (Cerro Macareno, Seville) The piece is made in bronze and it represents a seated woman naked with the right arm up and a very long hair in a typical Egyptian hairstyle. The piece is of special interest because of the votive inscription on its base. Written in the Phoenician alphabet, the inscription reads ‘this throne has been made by Ba`lyaton son of Dommilk and Abdba’l son of Dommilk son of Ysh’al for Astarte-Hor, our lady, because she has listened to the voice of their words’ (Amadasi 1992, my trans.). The statuette has been dated to the 7th-6th centuries BCE.

Another piece considered representative of the Phoenician tradition is the priest from Cádiz datning to ca. 7th century BCE (Fig. 3.11). The piece, made of an alloy of bronze, arsenic and zinc, represents a man in praying position and is thought to have been imported from Phoenicia. The iconography of the figure has been related with the Egyptian god Ptah, protector of metallurgy, although more current theories identify it with one of the deities that protected the trade activities in the ancient centre of Gadir (Cádiz). From Gadir is also a small bronze statue of the god Melqart with the Osiris tiara found on the island of Sancti Petri (Jiménez Avila 2002, 272-274) (Fig. 3.11).

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[16] The question of Tartessos is still controversial. Ancient Greek sources (from the 6th century BCE) refer to it as a civilization established in the south-west area of Andalucía normally related to mythical narratives. Herodotus (*Hist* 4.152; 1.163) is the first source to give historical details of Tartessos. For a long time, Tartessos was one of the main topics in historical research in the peninsula. Today, although its existence seems to be widely accepted, there is still a lot of uncertainty about the origins and disappearance of Tartessos (Aubet Semmler, 1989).

Fig. 3.11. Sculpture of the priest from Cádiz (CERES 3190) and the statue of Herakles-Melqart (CERES CE17004).

Within the stone production, the Dama de Galera, found in Galera, an Iberian necropolis in Granada, is especially interesting since although the piece is dated to the 6th century BCE, it was found as part of the burial goods of an Iberian tomb of the 4th century BCE. It is a small alabaster statue that represents a woman seated on a throne flanked by two sphinxes crowned by the typical Egyptian hairstyle. The piece is considered to have been produced by a Phoenician workshop on the peninsula, although it presents clear Egyptian influences in the iconography of the hairstyle and the sphinxes, and it was found as part of the burial goods of an Iberian tomb. Although it is impossible to know if the goddess represented was understood in the same way by both Phoenician and Iberian groups and in fact probably it was not, the object was valuable enough to be conserved and included in the tomb. This at least should be taken in consideration at the time to understand cultural contact between the different groups mentioned and how the biography of this object could have had a role in this further reutilisation by Iberian aristocrats.

Finally, the best-known Phoenician pieces in the sculptural production of the peninsula come also from Cádiz and are two white marble sarcophagi displayed in the Archaeological Museum of the city (Fig. 3.12). The male sarcophagus (ca. 4th century BCE) represents a bearded man holding a pomegranate in his left hand. The female sarcophagus (5th century BCE) represents a young woman with the Ionic hairstyle and a long tunic with a rectangular neckline and without any type of folding. The left hand holds a long alabastron. These sarcophagi are considered the best-quality Phoenician pieces of the peninsula.

Fig. 3.12. Phoenician sarcophagi from Cádiz (CERES CE00001, CE09773/1).

Together with Phoenician production, most of the sculptural pieces from the south of the peninsula have been identified as Iberian but have also been considered to have received strong influence from Greek workshops. To understand this process better, is fundamental to look at the history of sculpture production and acquisition by the Iberian communities. In comparison to the previous era, when Mediterranean import was the main activity, from the 5th century BCE the economic strategies of the Iberian communities started to change. Stockbreeding and agriculture grew significantly and became the object of large-scale export to Greek and Punic markets. This change in the economy caused a growth in population, and people started to be organised into *oppida* or fortified communities ruled by monarchs supported by a heroic past that was part of the collective imaginary (Almagro-Gorbea/Moneo 2000). At this time, the number of sanctuaries started to grow and with them the desire for sculptural production. Iberian sculpture is characterised by big sets of pieces found in funerary or ritual contexts. The representations include anthropomorphic and zoomorphic iconography, normally made from limestone and which are commonly found in sacred spaces located on the margins of the Guadalquivir Valley.

Traditionally, Iberian sculpture was thought to have been influenced by Greek traders. Nevertheless, most current discoveries have proved the use of sculpture in stone by the Phoenician communities in the peninsula. This practice would have been adopted by other indigenous communities who developed their own sculptural taste. At this time the Iberian workshops on the peninsula started to flourish producing sculpture to satisfy the necessities of the aristocratic class in some cases incorporating foreign artists and new influences from the Mediterranean (especially Greek and Italic models). These workshops initially depended on the aristocratic families that decided the type and quantity of production. Nevertheless, from the 4th century onwards, the workshops started to become independent and satisfied the more diverse necessities of the wider population. One example of this sort of production is the sculpture group of el Pajarillo (Huelma, Jaén) (Fig.3.13). The set was initially thought to be part of a necropolis; however, later discoveries proved its relationship with a heroic monument that rememorated a local legend. The group narrated the fight between a big wolf and a local hero that saved the indigenous communities from the danger (Molinos Molinos/Chapa Brunet/Pereira Sieso 1998).

Fig. 3.13. Sculptures of a warrior and the head of a Wolf from el Pajarillo, Huelma (Wikimedia Commons).

Another example is the sculpture group of Cerrillo Blanco (Porcuna, Jaén) (5th-4th centuries BCE) (Fig. 3.14). The set consists of several pieces in white limestone that were destroyed before being buried. The pieces show strong influence from archaic Greek sculpture and the whole set is highly homogeneous. Within the set there seem to be several groups of warriors fighting with each other as well as both real and fantastic animals such as griffins (Negeruela Martínez 1990).

Fig. 3.14. Sculpture of a warrior (left) and a warrior fighting a griffin (right) from Cerrillo Blanco (Porcuna) (Wikimedia Commons).

Together with Phoenician and Iberian productions, Punic influence has also been perceived in the sculptural record of Ulterior-Baetica, especially in the funerary sphere, where Punic influences are seen in burial rites, the typology of the graves and some features of the grave goods until well into the Roman period (Jiménez 2008a, 133). Punic influence was strongest in the eastern part of Spain, with Sagunto acting as a radiating focus of influence that spreads over the peninsula. Other examples of Punic production are also found in Cádiz and Baria with the well-known Phoeno-Punic terracottas of Astarte. Punic influence in the sculpture record of the peninsula remained until the late Empire as it has been attested by the more than 120 limestone busts dated between the Punic and the Claudian period in the oriental necropolis of Baelo Claudia (Tarifa, Cadice) (Jiménez 2007).

With Roman conquest, changes grew apace in the production of sculpture in Hispania with regard to materials, techniques and style, motivated by the first foundations in the Caesarean-Augustan period as well as the increase in numbers of settlers from the Italian peninsula especially from the 1st century BCE. The Eastern coastal regions and the Guadalquivir Valley are the areas in which the sculpture is more similar to Roman creations in this period, but the scholarship holds different positions. While some scholars have argued the possibility of a characteristically provincial/local way of sculptural production, theories based on the Romanisation model have traditionally addressed these differences as a progressive adaptation to the new Roman style that was being assimilated. Current and more accepted scholarship argues for the development of a hybrid production characterised by Iberian conception in conjunction with Greek and Roman styles (Jiménez 208).

In this group of hybrid production, one should include the sculpture sets discovered in the last decade of the 19th century in the excavations at El Cerro de los Santos (Albacete) and Osuna (Seville). At that time, many works were published on these pieces together with the products of other local workshops that were active in the Republican period such as Estepa (Moreno Onorato/Juárez Martín 1985; Barco 1994; López 2009) in Hispania Ulterior and Mallá (Rodá de Llanza 1993) and San Martín Sarroca (Guitart Durán 1975) in Hispania Citerior. There were lively debates in academia regarding the origin of the statues and much literature was published about the Ibero-Roman production, notable works including Pilar León (1993; 2009), Rodríguez Oliva (2002) Noguera Celdrán (1998a; 1998b; 2003) and Rodá de Llanza (1993; 1998; Jiménez and Rodá 2015). Most of this literature argues for the progressive introduction of Roman elements into the visual style of the peninsular south and a dilution of the indigenous style by the new influences, triggering a convergence of visual discourses.

The pieces in question often display local carving techniques, local materials and a visual language which is deeply connected with the local imagery, together with Roman iconographic patterns and style. Rodriguez Oliva (2006, 85) compares the sort of bilingualism displayed in this art with the bilingualism depicted in the legends of the coins minted in Ulterior-Baetica, a significant analogy that reflects very well the complexities of the cultural context of the period. These scholars see in this production a consequence of the hybridisation of the visual language (Jiménez 2008, 2011; Jiménez and Rodá 2015; Noguera Celdrán 2006), giving way to a new hybridised product that portrays a new interpretation of the artistic formulae brought to the peninsula by Italic migrant groups and establishing an uneven relationship between the traditional imagery and carving manner and the emulation of new Roman patterns (Rodriguez Oliva 2006). Nevertheless, this literature neglects the fact that the entanglement of cultural influences was not only Ibero-Roman but the product of an amalgamation of very different peoples and ethnic groups. In the same way that the coins do not only reflect the interplay between Iberian and Roman influences, visual arts display a genuine confluence of Greek, Iberian, Punic, Phoenician and Italic motifs.

In a recently published volume on Roman art in the provinces, Alicia Jiménez (2015) reflects upon the concept of 'province' and, by extension, of the label 'provincial'. In her view, our current perspective of the Roman provinces is deeply influenced by an idea of periphery which only makes sense when put in relation to Rome. The concept of province was a category generated by Romans that made sense in Roman times but has lost its original value. Current archaeology should therefore move beyond a differentiation between centre and periphery and understand the art of the provinces not only in relation to Rome as a radiating centre of influence but in its own terms and within a context-based analysis.

A similar question is discussed by Hijmans (2015) when addressing style changes in the Roman art of the second century BCE in Italy. In his view, pieces traditionally considered as ‘bad art’ for displaying a deviance from classical style, can no longer be considered a product of poor artistic skills. Hijmans points to the Etruscan sarcophagi from Volterra as an example of how style relies on meaning rather than beauty. These pieces do not conform to classical aesthetic considerations such as symmetry or real-size dimensions: the heads are represented on a different scale to the body, and the manufacture of the side of the sarcophagus seem to be much more careful than the body of the deceased itself. This is because this art was not considered in artistic terms in the first place, but rather in terms of semantics. In other words, the style of these pieces was defined by their function and meaning rather than artistic taste or skill. In Hijmans’ view, styles depicted in an image were chosen because of their communicative capacity in respect to the image and not necessarily their aesthetic contribution. Every time an iconographic element was selected, it brought in an associated network of meanings to be later reinterpreted by the audience in several different ways. If the readers of the image could not understand the whole semantic meaning behind it, says Hijmans, it is not because of the artist’s lack of skill but because the audience lacked the knowledge to decipher the communicative code employed. Therefore, the correlation between provincial agency and provincial style on its own is no longer a valid tool to understand this material. The unsightly character of these pieces is directly embedded in the style itself and it was chosen at some point because it did achieve a communicative objective.

Another model that seems to create new insights into the understanding of mixed visual discourses in material culture has been addressed by Revell (2013) in relation to the city of Verulamium (St Albans, UK). Revell reflects upon the utility of the concept of code switching to understand the way in which the city changed while maintaining pre-conquest meaning. In Revell's view, the way in which the conquering Roman groups established the new important monuments of the town in places that were important in the pre-Roman period allowed for the significance of these sites to be retained whilst being expressed in a new communicative code. These new centres retained their pre-conquest significance through their new location within the pre-conquest geographical distribution of ritual space. However, Revell argues that this retention of ritual meaning only lasted until the 3rd century CE when some of these structures went out of use or were rebuilt. This switch of code made sense in that moment because as Eriksen (1991) has demonstrated, several layers of identity can coexist within the conception of ethnicity. In this case, ethnic identities derived from the Roman state structure could coexist with a regional layer of ethnic identity. Revell extrapolates the relation between intra-Hellenic and pan-Hellenic communal identity in ancient Greece to support a similar model in the Roman Empire where instead of Roman or local, one could define two co-existing and not-exclusive levels of identity. In the case of Verulamium, participation in Roman administation, the name of the town, considered as a form of group definition, and activities including bathing, theatre and religious rituals did coexist with the pre-conquest origin of the name of the town, the ongoing commemoration of buried ancestors and the re-configuration of key places in the landscape.

3.5. Conclusions

This chapter has depicted the current landscape of the study of cultural interaction in Ulterior-Baetica on the basis of three different disciplines: epigraphy, numismatics and visual arts. It has discussed how approaches to the evidence have changed over time, giving way to an understanding of the products of the cultural interaction from very different angles.

In studies of the epigraphic record, the pre-Roman evidence is characterised by a strong Phoenician presence initially, which, after the fall of Carthage, started receiving the Punic influence. The influence of the Phoenician alphabet had a fundamental impact on the development of indigenous scripts. This evidence was characterised by the use of perishable media such as graffiti or *ostraka* in Phoenician contexts. Within the indigenous languages in the province of Ulterior-Baetica, the script of the south-west is of vital importance to understanding the development of the epigraphic culture in the area. The *stelae* of the south-west show a very early stage of epigraphic culture in the funerary sphere recorded in stone that has no other parallels on the peninsula. In this case, the writing habit was developed for the service of elite groups within the indigenous communities. Later, within the 6^{th} and 5^{th} centuries, a series of economic and social changes promoted the emergence of Iberian culture. The analysis of the evidence has demonstrated a tendency of the use of writing for the private sphere normally related to administrative purposes and property indicators. In terms of material, the use of stone for inscriptions was very limited in all the province (with clear exceptions such as the stela of Villaricos and the signario of Espanca).

The numismatic record reflects a very different landscape to that illustrated by the epigraphy. The iconographic types and scripts used in the legends on the coins reflect strong Phoeno-Punic influence and the prominence of Phoenician and Punic scripts recorded in the legends of the coins. The Phoeno-Punic language and writing remained in use throughout the period, mainly in coin legends but also in a less significant manner in pottery graffiti that remained until the late Empire in cities like Malaka, Sexs, Abdera and Baria. Apart from the prominence of Phoeno-Punic influences, the coinage of the province reflects a complex cultural interplay very different from that reflected in the epigraphic record. The coins combine a large number of iconographic influences, weight patterns and linguistic phenomena that range from bilingualism to mixed texts. The bilingualism of the mints has been especially underlined within the so-called Lybiophoenician mints.

Finally, in the case of the visual arts, again, the evidence displays a mixed panorama. On the one hand, traditional scholarship has categorised the pieces from the province of Ulterior-Baetica as either Ibero-Roman or Romano-Iberian, ignoring other cultural influences such as Greek, Phoenician and Egyptian that can also be perceived in the sculptural record. Analysing the different approaches taken toward the visual evidence has allowed a deeper exploration of the complex question of the variability of the visual discourse in the media. Applying models like bilingualism and code switching to the sculptural record of the province allows the reconsideration of sculptural objects not just as a means of displaying aesthetic or stylistic features but also as a means of transmitting meaning. This has helped in the understanding that style is not necessarily interlinked with carving skills, but is more related with the desire to transmit a specific message.

The evidence discussed in this chapter has been collected in a database implemented with semantic technologies. In the following chapters the different sorts of evidence will be analysed and queried in different ways in order to further explore the processes of linguistic contact both in the epigraphic and the numismatic record and iconographic contact both in the numismatic and the visual record. The epigraphic, numismatic and visual evidence conceived of in terms of the questions and approaches raised by scholars discussed here will be used to apply new approaches and methodologies to the question of how the different media record the cultural interaction amongst the different groups in the region in the Roman period.

Chapter 4: The Semantic Web

Overview

Chapter 3 explained the complexities of the cultural milieu of the province of Ulterior-Baetica between the 4th century BCE and the 1st century CE to further understand the evidence collected in the ERUB database. Chapter 4 draws upon a variety of sources to support the claim that interest and activity in the Semantic Web has grown in the last decade. It starts with a brief look at the concept of the Semantic Web and its significance today. It then expands upon the technologies required for publishing and linking structured and semantically enhanced data on the web. Finally, it concludes with an examination of the application of semantic technologies in current archaeological projects and the main issues encountered by classicists in applying LOD technologies.

4.1. Defining the Semantic Web

When Berners-Lee first described the World Wide Web in 1989, it was with the aim of generating an 'information space' in which both humans and machines could process, share and interconnect information (Berners-Lee 1989b). Nevertheless, the path once envisaged is yet to be accomplished. In the subsequent decades, most of the information published on the Web was in the form of documents. The Web was constructed as a collection of written documents that captured and presented natural language in a form legible to humans but not easy to process for software agents[17] (Nurmikko-Fuller 2015, 76). While computers could present and assist in the display of and search for information, only humans could process and create relations between the different resources. This

[17] Software agents are computer programs that develop functions on behalf of the user or other programs in a relationship of agency.

document Web or ‘Web of Documents’ was built on the idea of establishing hyperlinks between Web documents that could reside in different Web servers (Heath et al. 2011) functioning on a simple set of standards:

- Uniform Resource Identifiers (URIs) as the global identification mechanism
- Hypertext Transfer Protocol (HTTP) as the universal access mechanism
- Hypertext Mark-up Language (HTML) as the widely used format for the publication of contents

The generation of the ‘Web of Documents’ triggered the publication of a wealth of information on the Web. The material was aimed mostly at consumption and processing by humans as end-users. Humans can recognise meaning behind data, draw pertinent conclusions and establish relationships between different resources. They are also capable of inferring new knowledge through the context of the information and understanding circumstantial data. Nevertheless, when the user is not a human but a computer, a software agent, information needs to be presented in formats that allow the retrieval and extraction of data.

A lot of the latent meaning of information published on the Web resides in hyperlinks. Hyperlinks are references to new data that is somehow related to the main document or ‘anchor document.’ Hyperlinks can point either to a whole document or to specific elements within a document. To provide some examples, a hyperlink to a specific term could provide the definition of that term linking to a dictionary or a resource such as Wikipedia. A hyperlink to a statement, however, might provide an external reference to corroborate that statement. The text enriched with hyperlinks is called hypertext. The shift from the Web of Documents (WD) to the Semantic Web (SW) is rooted on the formalisation of the meaning of hyperlinks.

In the early 1980s, Knowledge Representation (KR) was one of the main foci of research, examining different ways to represent information about the world in a machine-readable format (Levesque 1984). The relation between KR and the SW is comparable to that between hypertext and the first version of the Web. While hypertext links allow users to navigate across the Web space using browsers, search engines organize the data and the links between them to ultimately infer information relevant to users' queries (Brin/Page 1998).

The process of publishing data on the Web in a machine-readable format that can also be linked requires a standard protocol so that different processers using those data can collaborate. Every day the number of data providers and application developers devoted to the standards of Linked Data increases, generating a global and interconnected data space known as the 'Web of Data'. Therefore, the 'Web of Data' is an information space in which the data is attributed a well-defined meaning and represented in a way that allows software agents to roam from one page to the next, obtaining relevant information to the users' initial queries. It seems necessary at this stage to make a small clarification regarding terminology. To many, the Semantic Web is not a collection of resources, but the body of principles and standards through which these resources are published. These people tend to consider these resources as the 'Web of Data'. There is a similar discussion regarding Linked Data (the principles) versus 'linked data' (the actual data). I therefore find it more useful to consider Linked Open Data as one of the technologies that make the SW possible, the SW being the set of principles and standards upon which such data is collected as well as the space where the linked data is hosted. In any case, the Semantic Web provides the foundation for a common space where data can be shared, processed, linked and reused across languages, cultures, applications, enterprises and community boundaries. It develops from a collaborative effort under the control of the World Wide Web Consortium (W3C) in which many researches and industrial partners play a role.

4.2. The Semantic Web today

In 2008, the W3C published the SPARQL recommendation, the standardised query language for the Resource Description Framework (RDF).[18] In the same year, Yahoo adopted RDF for its search technologies (Kummar 2008) and the *Semantic Web for the Working Ontologist* —a guide to implementing semantic ontologies— was published, (Allemang and Hendler 2008). The subsequent years saw the advent of several improvements such as the standardisation of OWL2 —an extended version of OWL.[19] Additionally, the UK government data store adopted semantic technologies (Tennison 2010).

After 2010, developments continued in quick succession: The Semantic Web Journal was launched (Hitzler/Janowicz 2010) and the '5-star data' rating system was added to the 'Linked Data' Designing Issues post (Berners-Lee 2006 edited in 2010). Two years later, Google introduced its Knowledge Graph (KG). Knowledge Graphs are one of the main components of the Semantic Web and they consist of any graph-based data repositories[20] (Shingal 2012). The Semantic Web uses KGs in which the data is stored in RDF, so they

[18] RDF is is the standardised language to publish linked data on the Web. For more on RDF see 4.2.2.
[19] OWL stands for Web Ontology Language, a type of mark-up language to write ontologies.
[20] Graph-based data repositories are databases that use graph structures to allow semantic queries with nodes, edges and semantic properties to visualise and store the data.

are also called RDF graphs. An RDF graph consist of a certain number of triples where each triple is an information statement in the form of subject, predicate and object.

Research on Knowledge Graphs and the Semantic Web in the last decades has been increasingly in the spotlight, to the point that some have considered current times as the knowledge graph era (eg. Poupeau 2019). This new era would have started in 2014 with the Knowledge vault announcement by Google (Dong et al. 2014) and it was reinforced in the last year (2019) with the workshop celebrated in Berlin under the title 'Web standardisation for graph data'.[21] Recent scholarship on KG tends to describe some of their characteristics without providing a definition, therefore triggering some confusion (Blumauer et al., 2016; Farber et al., 2015). Ehrlinger et al. (2016) have tried to produce a clear definition of each of the terms involved in the constitution of a KG. According to them, a KG consists of a knowledge base (e.g., an ontology) and a reasoning engine that allows inference and the production of new knowledge. Therefore, the term Knowledge Graph should not be used interchangeably with related but distinct concepts such as ontologies or knowledge bases.

Statistics collected by Bernstein et al. (2016) show that over 2.5 billion Web pages have mark-up following schema.org specifications and are using shared vocabularies to describe their content.[22] Together with this, increasing numbers of individuals, organisations and institutions are using LOD technologies as a way of retrieving and querying their data and LOD is becoming a widely used resource in areas such as medicine and banking. As an example, in 2012 the World Health Organisation was

[21] https://www.w3.org/Data/events/data-ws-2019/ (accessed June 2020).
[22] Schema.org provides a set of schemas to structure data on the web. The vocabularies include entities, relationships between entities and actions. See https://schema.org/ (accessed June 2020).

developing the first international vocabulary for disease in ontology format (Tudorache et al., 2013). As of the last five years, the aims in this field are more oriented towards the implementation of semantic interoperability between the different controlled vocabularies in medicine (Tricai and Wayne 2015).

The state of the LOD cloud provides an overview of the topology of the web of data. The latest version of the Linked Open Data Cloud was released in May 2020.[23] The diagram (Fig.4.1.) shows the datasets that have been published in linked Data format starting at 2007 when the cloud was constituted of just 12 datasets.

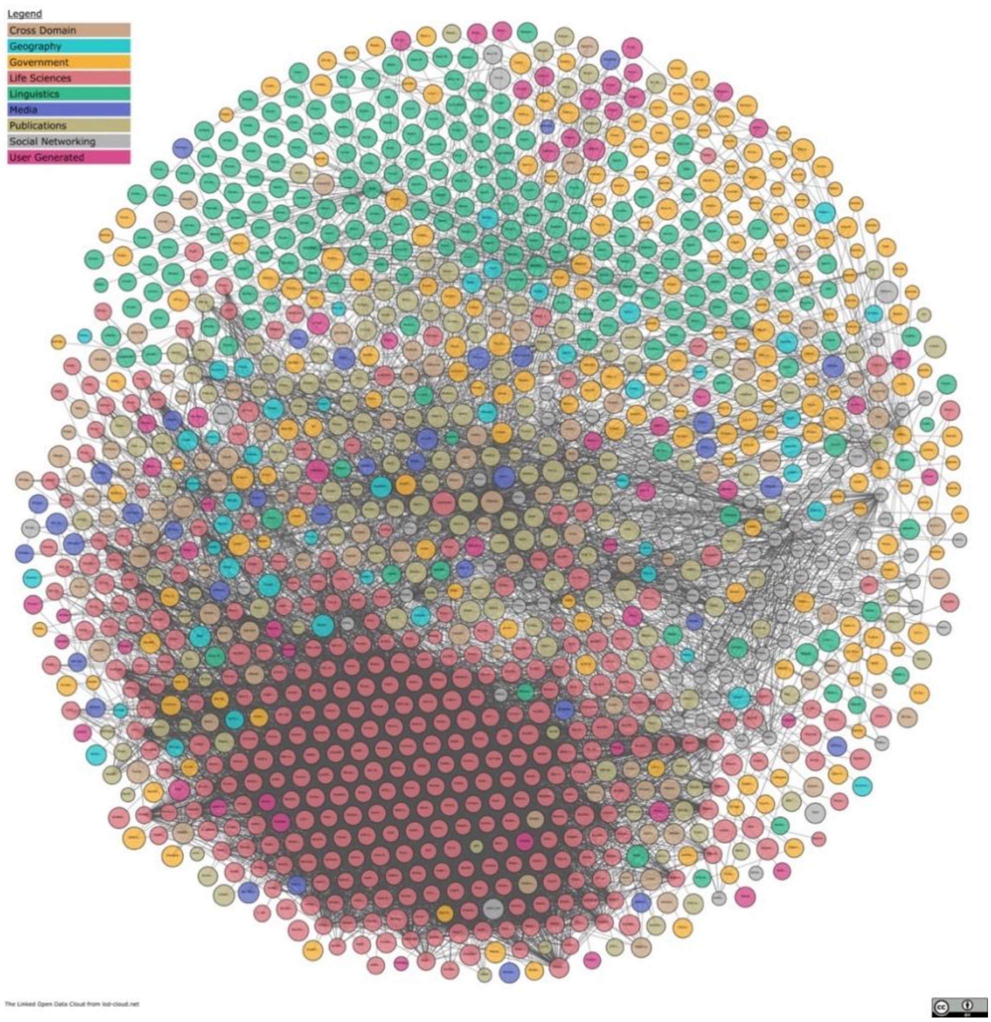

Fig. 4.1. Diagram of the Linked Open Data cloud (source: https://lod-cloud.net).

[23] See https://lod-cloud.net/ for the full version of the cloud diagram (accessed May 2020).

The number of datasets as of May 2020 is 1,255 with 16,174 links among them showing a growing tendency from 2007. The site also offers a list of the different subclouds by domain, which have been listed in the following table 4.1.

Domain	***Datasets***
Geography	48
Government	200
Life sciences	343
Linguistics	133
Media	38
Publications	151
Social Networking	54
User generated	68
Cross domain	73
Other	147
Total of Datasets	1,255

Table. 4.1. Classification of datasets by topical domain (data taken from https://lod-cloud.net/lod-data.json).

From the table, one can see that the most active domains at the moment are life sciences, government and publications, which is not altogether surprising. In the case of the life sciences, the Semantic Web has specially stimulated the development of ontologies to implement the discovery of implicit associations between heterogeneous data and knowledge sources. In this field, the application of Linked Data principles has transformed the publication of data creating a huge web of Life Sciences Linked Open Data cloud (LSLOD) (Kamdar 2018).

Regarding governmental bodies, countries like the UK and USA have developed in recent times an interest in promoting internal transparency (Heath et al., 2011).[24] This initiative has led to a significant publication of data on the Web that allows the public to perform deeper analytics on the data, most recent examples of this being Czechia and Greece[25]. A similar situation is experienced by libraries and education. One of the main objectives behind the publication of LOD on the Web is the improvement of information discoverability and libraries were part of the LOD community from the very beginning, quickly becoming a fundamental contributor of data. The main purpose is the integration of library catalogues and metadata to enable subsequent interlinking according to instances, domains, location or historical period (Heath et al, 2011). The American Library of Congress is one of the most popular examples in the field because it is one of the largest libraries in the world and one of the first to publish their taxonomies as Linked Data.[26]

Another field that has developed much interest within the Semantic Web especially in the last decade is Linguistics, being one of the most prominent domains in the cloud and instigator of a new movement known as Linguistic Linked Open Data (LLOD).[27] The movement aims to encourage the publication of data for linguistics and natural language processing using the LOD principles. Most of the data generated comes from academic projects including a varied range of datasets from corpora, lexicons, dictionaries and terminologies to larger datasets of linguistic resources, linguistic data categories and typological databases, some examples are the Open Linguistics Working Group (OWLG),

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24 The UK government open data service (http://data.gov.uk) redesigned in 2018 and the US government open data portal (http://www.data.gov) (accessed May 2020).

25 http://greek-lod.math.auth.gr/police/ and http://greek-lod.math.auth.gr/police/ (accessed May 2020).

26 https://id.loc.gov/ (accessed May 2020).

27 https://linguistic-lod.org/ (accessed May 2020).

the Linked Data and the Linguistics Metadata Repository (LingHub).[28] Within the LLOD, one of the examples of corpora is provided by the DBpedia abstract corpus.[29] This project contains a conversion of Wikipedia abstracts in six languages which was supported by the FREME H2020 project.[30] DBpedia is also one of the most typical examples of cross-domain datasets. It was constituted from publicly available Wikipedia dumps[31] and it provides one of the biggest datasets for entity linking together with YAGO, Wikidata, CrunchBase and UMBEL (Noullet et al. 2020).[32]

In the media sector, Linked Data technologies have been used to implement websites for bodies such as the BBC and the New York Times, allowing the publication of data on the Web in the form of controlled, typed and disambiguated links. The BBC released in 2008 a site that provides a URI and an RDF description for each of the episodes collected in their dataset (Kobilarov et al., 2009). Later, the company also released *BBC Things*, a repository that provides references for the collection of entities mentioned on the site. [33]

The field of geography has attracted the attention of LOD providers from the beginning of discussion of the SW because of its capability to serve as a connector of information from different domains. The GeoNames databank is one of the best examples of how a dataset can serve as a hub for other repositories whose data present some geographical component.[34] GeoNames is an open-licensed geographical dataset that as of March 2020

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28 https://linguistics.okfn.org/; http://linghub.org/ (accessed May 2020).
29 http://downloads.dbpedia.org/2015-04/ext/nlp/abstracts/ (accessed May 2020).
30 http://freme-project.eu/ (accessed June 2020).
31 A Database dump contains a copy of the structure and the data from a specific database.
32 http://umbel.org/; https://www.mpi-inf.mpg.de/departments/databases-and-information-systems/research/yago-naga/yago/#c10444 (accessed May 2020).
33 https://www.bbc.co.uk/things (accessed May 2020).
34 https://www.geonames.org/ (accessed May 2020).

contains over 25 million geographical names. Other examples of geographical datasets are LinkedGeoData and the Pleiades Gazetteer.[35]

Because of its transversal nature, the heritage sector is not reflected as a single domain in the cloud. Bodies within this field include libraries and museums but also galleries and other sorts of public collection of community legacy. In spite of this, the heritage sector plays a crucial role in the Semantic Web development, in fact, the last decade has seen the launch of several national and international projects that promote the discoverability of information and the dissemination of data concerning material culture (Europeana, PARTHENOS, CrossCult, ARCHES, ARIADNEplus etc.).[36] One of the biggest challenges that these projects face is the production of heritage data that needs to be made available in different languages and by different platforms. Whereas earlier solutions focused on the syntactic interoperability of the data, without promoting the inner semantic structures of the information, later advances have moved the focus to the underlying semantics of the data sources, making both the semantics and the content interoperable (Janowicz 2019).

In this context, already existing knowledge representation models have developed further, such as the CIDOC Conceptual Reference Model (CIDOC CRM) first published in 2000, and currently considered as one of the main ontologies for the representation of cultural heritage concepts. The CIDOC Conceptual Reference Model is an object-oriented ontology that conceptualizes and structures heterogeneous cultural heritage information

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35 http://linkedgeodata.org (accessed May 2020); Pleiades is reaccessed in this thesis as an international resource for the ancient world in Chapter 5, for further information see 5.2.1.1.

36 https://www.europeana.eu/es; https://www.parthenos-project.eu/; https://www.crosscult.eu/; https://www.archesproject.org/; https://ariadne-infrastructure.eu/ (accessed June 2020).

from museums, libraries and archives (Gill 2004). Although it was not originally intended as an LOD ontology, the CIDOC CRM has grown into a core semantic framework for the key concepts implied in cultural heritage documentation.[37] A new version in development was published as an 'open-in-progress' work in September 2017. In 2009, the Semantic version of the British Museum database was enhanced with the CIDOC-CRM ontology (Oldman 2009). Two years later, in 2011, the British Museum released the semantic version of its database, being the first UK institution to publish its catalogue online in LOD.[38] This endeavour allowed the public to have direct access to the museum database in the form of raw LOD through a tailor-designed web application called ResearchSpace.[39] Furthermore, it allows software developers to produce new applications to manipulate and reuse data, opening a whole new path into research.

In the last decade, there has also been broader investment and support by funders and networks in the Semantic Web. A leading example, the *Pelagios Network*, formerly *The Pelagios Project and Pelagios Commons*[40], is one of the largest collaborative endeavours in this field that has been well-received by the Classics community, as shown by the quick growth in both collaborators within the *Pelagios* consortium and the number of interfaces using *Pelagios*-based tools and data (Beale 2012). The *Pelagios* community has demonstrated the viability of collecting different references based on gazetteers of toponyms in the context of ancient world linked data.[41] Toward that end, the project has contributed a series of tools, systems and recommendations that have become fundamental for the non-expert user in the last decade. Two of the best-known resources

[37] http://www.cidoc-crm.org (accessed June 2020).
[38] Museum semantic data package published in 2012 https://old.datahub.io/dataset/british-museum
[39] ResearchSpace is reaccessed in this thesis, for further information see 5.2.1.2.
[40] http://commons.pelagios.org; for Pelagios network see https://pelagios.org/ (accessed June 2020).
[41] The Pelagios project is reaccessed in this thesis, for further information, see 5.2.2.2.

are *Recogito*[42] and *Peripleo*[43]. *Recogito* was developed to allow the encoding of data related to texts, places and archaeological objects linking it to two already exiting gazetteers, *Pleiades* and *GeoNames*. The tool offers several outputs once the data is encoded including CSV, RDF and KML, allowing the further reutilisation of the information. *Peripleo* is a search and browse interface that allows the navigation among the more than 900,000 items collected by the 48 data sources contained in the system. After several grants awarded by JISC[44] and the Andrew W. Mellon Foundation[45], in 2019 the Pelagios Commons project became the Pelagios Network[46], an association of independent partners governed by a Committee that designs the strategy and areas of focus. Within the Pelagios Network, Linked Pasts deserves a special mention. The initiative first started as a (Pelagios-led) conference in 2015. As of May 2020, the group is getting more active within the community. The last meeting was in 2017 in London on a workshop focused on how to extend the Pelagios coverage beyond geographical entities (Grossner/Hill 2017).

Similar to the labor developed by the Pelagios project, DARIAH-EU is a pan-European infrastructure for arts and humanities.[47] The project aims to enhance and support digitally enabled research across the arts and humanities including workshops and training events, some of which are focused on LOD and the Semantic Web. In a similar approach to DARIAH, CLARIN ERIC is the European Research Infrastructure for Language Resources and Technologies. It provides a variety of resources including datasets to

[42] see Simon et al. 2019 for an introduction to Recogito which was recognised by the Digital Humanities Awards in 2018 as the Best Digital Humanities Tool: http://dhawards.org/dhawards2018/results/ (accessed June 2020).

[43] https://peripleo.pelagios.org; https://peripleo.pelagios.org/about (accessed June 2020).

[44] https://www.jisc.ac.uk/ (accessed June 2020).

[45] https://mellon.org/ (accessed June 2020).

[46] https://pelagios.org/about-us/ (accessed June 2020).

[47] https://www.dariah.eu/ (accessed June 2020).

scholars, researchers and students in all different disciplines especially humanities and social sciences, comprising a wide network of organisations and members from different countries.[48]

Finally, the Getty Research institute based in California is widely known especially in the art history field for its contribution to the study of visual culture. The institute provides open access resources including their art collections, libraries and more than 10,000 artwork images in open access. In the last decade, the Getty Research institute has especially contributed to the LOD community with the publication of open access vocabularies available in the LOD format. These vocabularies provide structured terminology for art, architecture, decorative arts, archival materials, visual surrogates, conservation, and bibliographic materials. In May 2019, Getty released an API web service to help heritage institutions reconcile metadata with their thesauri.[49]

The recent emergence of the projects and initiatives discussed above, suggests a growing interest in Digital Humanities and especially in the Semantic Web and its future. These projects continue to contribute semantically enhanced data to the web and enlarging the LOD cloud. The huge amount of data available has changed the research landscape. If in the first years, the main objectives were to develop standardised techniques and methods to guarantee the openness and decentralisation of LOD, current research focuses on the best ways to promote the use and linkage of the data that could in the future become the base for further developed and implemented intelligent applications (Bernstein et al., 2016).

48 https://www.clarin.eu/ (accessed June 2020).

49 https://www.getty.edu/research/tools/vocabularies/obtain/openrefine.html (accessed June 2020).

4.3. Current technologies

The Semantic Web encompasses, by definition, the development and use of semantic technologies, but the two terms refer to different concepts. Semantic technologies such as Linked Open Data (LOD), Unique Resource Identifiers (URIs) or ontologies are used in the modelling, integration and publication of structured data that will later be linked and shared in the knowledge space known as the Semantic Web. In other words, the Semantic Web is the big umbrella under which all this data is published and interconnected through the means enabled by semantic technologies.

4.3.1. Uniform Resource Identifiers (URIs)

The best practices that allow LOD to be published were stated in Chapter 1 as specified by Tim Berners-Lee in 2006. The first of these recommendations is the identification of an atomic unit of data by a so-called Uniform Resource Identifier (URI). LOD uses URIs not only as identifiers of Web documents but also as 'resources' or specific pieces of data. URIs allow the identification of the resources and their disambiguation by connecting them to a specific authority list that recognises and defines them. The resources can vary from tangible things (people, places, settlements) to abstract concepts such as time periods, or indeed the juridical status of a specific settlement during the Roman domination of the Iberian Peninsula (e.g., *municipium* or *colonia*). This principle allows the extension of the scope of the Web from the display of online resources to the representation of any concept (Heath et al., 2011).

The HTTP protocol is the mechanism that allows universal access across the Web. In the Web of Documents, URIs combine globally unique identification schemes with a simple mechanism of retrieval of the queried site. In the Semantic Web, HTTP URIs are used to identify pieces of data (i.e., objects or abstract concepts). This enables the URIs to be processed over the HTTP protocol into a description of the specific resource. URIs consist of two main sections: the ‘URI Scheme Name’ (e.g., ‘HTTP’ ‘URN’ or ‘DOI’) and the scheme-specific section (the syntax of which is scheme dependent) separated by a colon. Linked Data only uses HTTP URIs; first, because they provide a way to generate globally unique identifiers in a decentralised manner, and second, because they not only serve as a name but also as a means of displaying information by describing the specific entity.

Examples of HTTP URIs are:

- http://pleiades.stoa.org/places/256503
- http://nomisma.org/id/urso
- http://edh-www.adw.uni-heidelberg.de/edh/inschrift/HD000777

HTTP URIs should be referenceable: when one is given as input to HTTP client software (e.g., a Web browser, ontology editor, HTTP client library for the Java or Python languages, or the cURL programme) the output —i.e., the content of the HTTP response— should be a description of the resource that is at the same time identifiable by the URI. Depending on the client software and the request it makes, the description should be either human-readable or machine-readable. In the former, the information about the resource might be presented in the format of Web documents i.e., HTML. In the latter, the description is provided as data in RDF or other formats. For example, in Fig. 4.2, one can see the information retrieved by the URI stated as an example before (http://edh-www.adw.uni-heidelberg.de/edh/inschrift/HD000777). This URI provides a classic HTML Web document that at the same time allows the data to be represented and downloaded in RDF. The content retrieved from the URI needs to be readable for both humans and machines and this can be accomplished through a mechanism called ‘content negotiation’. This protocol allows HTTP clients to send a request indicating what type of documents they require. Servers inspect this query and send back the required information.

Fig. 4.2. Screenshot of the HTML retrieved from the URI provided.

The use of URIs to identify entities allows the enrichment of the information by external resources, enabling the identification of the same entity in different datasets. To do this, the data published by the different datasets needs to be presented in a standardised format accessible to everybody.

4.3.2. Resource Description Framework (RDF)

In the same way as the Web of Documents needed hypertext for data to be published in a standard format, LOD needs RDF for data to be structured and semantically enhanced. RDF, or Resource Description Framework, is the standard language used to publish linked data on the Web. RDF is a simple language that at the same time allows the encoding of complex knowledge.

RDF has been designed as a kind of *lingua franca* that allows the publication of data on the Web in a standardised format that follows an extremely syntactic paradigm and has been specifically designed to connect different sources of information (Heath et al. 2011). A resource is described in RDF by several 'triples.' Each triple is a statement, a sentence constituted by three elements: subject, predicate and object as seen in Fig. 4.3.

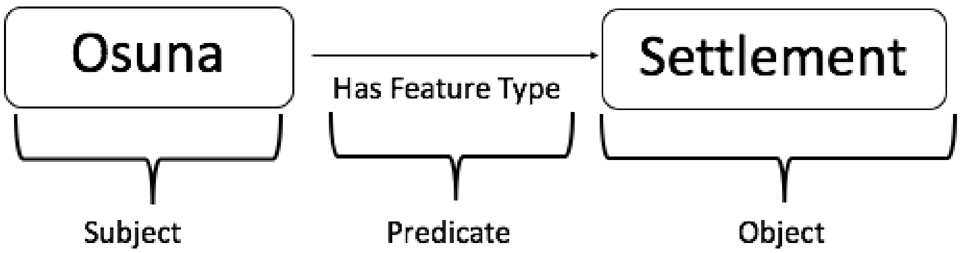

Fig. 4.3. Graphical representation of a triple.

The subject and object of the triple are connected by the predicate. This element is the one that enhances the statement, establishing a labelled relationship between the two elements and therefore attributing a specific meaning to the data. Subject and predicates are always resources. Objects can be resources or literals (i.e., a string of text or a number that attributes a simple value and not an identifier). As for the resources in question, the predicate must be a named resource (with a URI), while subject and object resources can be named or anonymous. The predicate URIs or values tend to come from 'vocabularies':

these are collections of resources that can be used to represent information from a certain domain.[50]

When we attribute a URI to each of the elements of the triple, the information collected is enriched by the data coming from other sources and therefore identified and disambiguated:

Osuna [(https://pleiades.stoa.org/places/256503)](https://pleiades.stoa.org/places/256503)

  Has Feature Type [(https://pleiades.stoa.org/vocabularies/place-types)](https://pleiades.stoa.org/vocabularies/place-types)

    Settlement [(https://pleiades.stoa.org/vocabularies/place-types/settlement)](https://pleiades.stoa.org/vocabularies/place-types/settlement)

RDF is not a data format, but a data model that can be serialised in different formats, the most common standard ones being RDF/XML, JSON-LD, RDFa (when it is embedded in HTML), Turtle and N-Triples (a subset of Turtle). The following are some examples of the different serialisation formats for the RDF of the resource 'Osuna/Urso' in Pleiades, a gazetteer of the ancient world.[51] Please note that the case of the URIs ending in '#' is a particular convention chosen by Pleiades which does not always apply.

RDF/XML[52]

```
<?xml version='1.0' encoding ='utf-8'?>
<rdf:RDF
  xmlns:rdfs='http://www.w3.org/2000/01/rdf-schema#'
  xmlns:spatial='http://geovocab.org/spatial#'
>
 <spatial:Feature
rdf:about='https://pleiades.stoa.org/places/256503#this'>
  <rdfs:label>Urso/Col. Genetiva Iulia</rdfs:label>
```

[50] See for example Pleiades vocabularies for places at https://pleiades.stoa.org/vocabularies .

[51] https://pleiades.stoa.org/places/256503 (accessed May 2020).

[52] Note that the sample of the data format has been coloured to facilitate interpretation.

```
  <rdfs:comment>An ancient place, cited: BAtlas 26 E4 Urso/Col.
Genetiva Iulia</rdfs:comment>
</rdf:RDF>
```

Since RDF/XML syntax was standardised by the W3C, it has been a commonly used format to publish LOD. The example above shows the serialisation of two RDF/XML triples. First, there is the announcement of the XML version and Unicode encoding, then there is the list of RDF prefix specifications that are going to appear in the triple, then the subject, predicates and objects. Although RDF/XML has been widely used in LOD, it is considered to be one of the less human-readable formats, also it is not very practical for huge data dumps, as many RDF parsers need to parse the whole XML document before being able to extract a single triple from it.

In contrast to RDF/XML serialisation, Turtle syntax is considered to be one of the easiest formats for humans to read and write. The following example of Turtle shows first the name specifications of the ontologies that are going to appear in the triple (i.e., @prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>) followed by the actual triple. The triple consists of the subject (i.e., https://pleiades.stoa.org/places/256503#this), followed by the predicate (i.e., 'a') and the object (i.e., http://geovocab.org/spatial#Feature with a label (i.e., rdfs:label 'Urso/Col. Genetiva Iulia').

Turtle

```
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix spatial: <'http://geovocab.org/spatial#'>.

<https://pleiades.stoa.org/places/256503#this> a
<http://geovocab.org/spatial#Feature>;
  rdfs:label 'Urso/Col. Genetiva Iulia';
  rdfs:comment 'An ancient place, cited: BAtlas 26 E4 Urso/Col.
Genetiva Iulia'.
```

RDF by itself is just a data model that allows the compilation of information in a standard way so that it is readable by both humans and machines. However, in order to semantically enhance the data, we need shared vocabularies for software agents to treat those data in accordance with their meaning.

4.3.3. Ontologies

Ontologies are vocabularies that may represent any possible form of knowledge (Pattuelli et al. 2015, 265). By establishing different classes and properties, ontologies can provide a common reference for both the data source and the consumer, establishing the type of relationship between the URIs they are mapping (Isaksen 2011, 77). They are a means to represent knowledge by configuring concepts, most notably as classes, their instances and the relationships that connect them. Although ontologies started as a key focus in research in the field of artificial intelligence, since 1999 they have become one of the cornerstones of the LOD ecosystem (Berners-Lee/Fischetti 1999).

Apart from the ever-increasing number of ontologies that are being developed by different projects, the W3C has standardised three meta-ontologies that help in the understanding of these models of organised knowledge. These are the RDF Schema (RDFS) (Brickley/Guha 2014), the Web Ontology Language (OWL) (McGuiness/van Harmelan 2004) and the Simple Knowledge Organisation System (SKOS) (Miles/Bechhofer 2009). RDFS[53] provides a data-modelling vocabulary for the definition of classes, properties and the hierarchies involved. Built on top of RDFS, OWL comprises a higher level of formalism in the description of classes and properties and provides tools for the representation of new concepts and more complex relationships (Patuelli et al, 2016). It

53 https://www.w3.org/TR/rdf-schema/ (accessed May 2020).

also relates to description logics: depending on the fragment of the language chosen, the OWL specification includes several variants which may influence the computational cost of reasoning on ontologies. [54] Finally, SKOS is an OWL ontology also recommended by the W3C for the description of taxonomies and thesauri, but especially, to support data mapping. In other words, it provides properties to allow alignment between datasets *(i.e., skos:exactMatch, skos:broadMatch, skos:narrowMatch, skos:closeMatch and skos:relatedMatch).*

Although ontologies are an ever-increasing field of research and every day there are continuous advances in knowledge representation, there is no expectation for a single ontology to be capable of classifying all the knowledge in the world. Because of this, some projects use several ontologies (regarding different domains) or cross-discipline examples that allow the coverage of different sections of knowledge. In the LOD ecosystem, it is best practice to use ontologies that are already available online and normally related to several datasets. This practice improves interoperability, saves time and makes data easier to understand and process using generic applications (Heath/Bizer 2011).

Nevertheless, despite the many advantages of using already existing ontologies, it can be very difficult at times to find an ontology for a specific project or the necessary vocabularies to represent a certain field of research. In such cases, there are two possibilities: one can either extend an existing ontology with the aspects that have been found missing (see, e.g., Kyvernitou/Bikakis 2017), or a new ontology can be developed

[54] For OWL variants see OWL-Lite, OWL-DL and OWL-Full (ordered by expressiveness) for OWL1 and OWL-EL, OWL-RL and OWL-QL for OWL2.

from scratch. This last option potentially constitutes a long and difficult endeavour that ideally requires the participation of a whole research team with different experts covering different fields of the domain (Gomez-Pérez/Fernández López/Corcho 2004).

The process of developing an ontology from scratch has been framed as seven different steps by Pattuelli et al. (2016, 269):

a) Specification, focusing on the definition of domain and scope
b) Modelling, where key concepts, properties and the relationships between these two are defined
c) Generation, where the data sources are integrated into RDF using the vocabulary established in the previous phases
d) Matching, where the ontology is linked, establishing correspondences with other ontologies by the use of predicates that imply similarity e.g., skos:exactMatch, class equivalences in OWL and OWL:sameAs. It is important to note here that an ontology does not necessarily need to be first modelled and then linked. Some ontologies are born directly linked
e) Publication
f) Exploitation

Together with the publication of the ontology, it is recommended to publish the data for which it was originally designed, allowing the consumption and querying of the data and therefore the utilisation of both the ontology and the dataset in parallel.

For as long as the Semantic Web has been a reality, there has also been criticism of the main approaches that it proposes and the technical abilities that it presumes from end-users. The first critique came as early as 2003, when some of the most general concerns were about the impossibility of the Web (through correspondent technologies) representing the richness of human semantics (Uschold 2003). From the beginnings of

Digital Humanities, the idea of translating human organic knowledge into a constrained and structured model of data has always been controversial. The main problem comes when trying to give a specific structure or order to something as fluid and dynamic as human knowledge.

In the last decade, with the development of Semantic technologies and the implementation of ontologies, the possibilities of knowledge representation and the decisions that should be made at the time of mapping a dataset have again attracted interest (Bodard 2020). Many decisions need to be made when a certain domain is represented through a hierarchy of classes and properties. Although the modelling of knowledge can be a biased, distorting and, on some occasions, misleading exercise, it becomes also fundamental for the researcher to take an active role towards the data and make some decisions where necessary. Many new projects are emerging that need to make important decisions in order to model their data, especially regarding fields such as gender, ethnicity or other realities difficult to constrain into boundaries or exclusive categories. Whatever approach to this question is taken, the main concern should be the full documentation of decisions taken and the specification of each of the categories as well as the awareness of difficulties that might have emerged along the way.

4.4. The Semantic Web and archaeology

Archaeology, as the science that studies the material evidence of the human past, has been considered the discipline that deals with 'the biggest dataset of all: the entire material record of human history' (Dunn 2017, 1). The managing of a dataset such as this poses serious difficulties as a result of dealing with a material record that is in most cases incomplete and structured into chronological classifications that distribute data artificially across different and disconnected periods of time (Moreno Escobar 2011). Photographs, GIS information, images and data from remote sensing, analytical and descriptive data sets, tabular data, numerical databases and texts are only some of the examples of data that archaeologists deal with. Furthermore, the generation of archaeological data is generally only the first step of any research project. After the collection and processing, information needs to be analysed, interpreted and interpolated in the process of archaeological investigation (Dunn 2017): consisting of materials and research published outside academic and commercial standards, it lacks any systematic means of distribution and collection, making it difficult for scholars to discover, evaluate, and again interconnect the information.

Due to the continuous growth of archaeological databases, data management has become an essential requirement in the field. Traditional ways of collecting, cataloguing and preserving data in archaeological research such as relational databases have limitations not only in information processing but also in the quality of results obtained when developing more complex queries. Programmes such as dBase[55] were traditionally used and MonArch[56] was specifically designed for application to archaeological data. From the 1990s onwards, other software such as Access[57] and FileMaker Pro[58] gained more popularity; nevertheless, there were still problems triggered by the application of these technologies, such as access to information stored in institutional repositories. Conventional data management technologies do not allow the cross-search of different

[55] dBase is a database management system for microcomputers that includes a database engine, a query system and a programming language. It was developed by Ashton-Tate in 1980. http://www.dbase.com/.
[56] MonArch is a joint research project developed by the University of Passau and the University of Bamberg aimed to the preservation of archaeological data. http://www.monarch.uni-passau.de/en/. (accessed May 2020).
[57] https://products.office.com/en-gb/access (accessed May 2020).
[58] http://www.filemaker.com/ (accessed May 2020).

data repositories even in cases where those repositories have been made available online (Tudhope et al., 2011).

The necessity of making research data available is generally increasing. In the field of archaeology, several repositories of curated data have emerged or become publicly available in recent years both in Europe and America. Some examples are *Arachne* in Germany, *The Archaeology Data Service* in the UK, *DANS e-depot* in the Netherlands *The Digital Archaeological Report* in the USA and *the Instituto Andaluz de Patrimonio historico* in Spain. [59] Nevertheless, it is still very difficult for the researcher to run global queries across the different institutional repositories. Semantic technologies have proven to be a possible solution to cross-search different datasets from a single query. However, there are still some problems, including differing terminology, database schema and database structure (Tudhope et al. 2011).

Beyond the world of LOD, over the last few years, the use of ontologies has gained popularity in the field of data management. In this context, the paradigm of ontology-based data access (OBDA) aims to break down the technical barriers between the user and the data by providing an ontology that allows the querying of information without requiring authority knowledge of it (Lenzerini 2011). Large projects have been developed by universities across the UK that deal with the difficulties derived from data management through the creation of ontologies. *Tracing Networks: Craft Traditions in the Ancient Mediterranean and Beyond* (2008)[60], for example, has demonstrated the possibilities for data management through the development of ontological databases. Another project that

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59 http://arachne.uni-koeln.de//drupal/; http://archaeologydataservice.ac.uk/; https://dans.knaw.nl/en; https://www.tdar.org/; www.iaph.es (accessed May 2020).

60 http://www.tracingnetworks.ac.uk (accessed May 2020).

has not applied ontologies so far but could represent a very good case study because of the necessity of establishing relationships between the data is *Engendering Roman Military Spaces* (2008)[61]: this endeavour converted legacy data into relational databases using Optical Character Recognition software (OCR) on previously published reports. In the field of ancient ceramics, the large amount of data led to the establishment of *Big Data on the Roman Table* (2015), a macro project that aims to create a wide network to deal with the enormous quantities of Roman pottery data.[62]

In UK scholarship, many projects were born from the premises of ‘openness’ and ‘linkage’ of information. Some of the first to incorporate LOD technologies to the archaeological research were *STAR*[63] (Semantic Tools for Archaeological Resources), *STELLAR*[64] (Semantic Technologies Enhancing Links and Linked Data for Archaeological Resources) and *SENESCHAL*[65] (Semantic Enrichment Enabling Sustainability of archaeological Links). They are all led by the University of South Wales and employ Semantic Web technologies to enhance the discoverability of archaeological data and literature that would otherwise be difficult to access.

Since 2005, many other projects have emerged related to the aggregation and further dissemination of archaeological material (Isaksen 2011, 42). The *Nomisma*[66] project relies on RDF to combine data on Greek and Roman coinages so that the results of SPARQL queries can be visualised online or downloaded in different formats and

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61 http://archaeologydataservice.ac.uk/archives/view/milspace_leic_2008/ (accessed May 2020).

62 http://www2.le.ac.uk/departments/archaeology/research/previous-research-projects/big-data-roman-table (accessed May 2020).

63 http://hypermedia.research.southwales.ac.uk/kos/star (accessed May 2020).

64 http://hypermedia.research.southwales.ac.uk/kos/stellar (accessed May 2020).

65 https://hypermedia.research.southwales.ac.uk/kos/seneschal/ (accessed May 2020).

66 http://nomisma.org/ (accessed May 2020).

processed by the user (Gruber et al., 2011). Other major national archiving initiatives have also included Semantic Web formats to expose and sort archaeological data. The German Archaeological Institute's *Arachne*[67] database contains, for example, more than 2,000,000 images linked to related metadata and structured descriptions of artefacts and archaeological information of interest (Felicetti et al., 2015).

A place to see the influence of LOD technologies in archaeological research is the *International Computer Applications and Quantitative Methods in Archaeology Conference (CAA)*. Isaksen (2011 Chapter 2) provides a survey of Abstract and proceedings from CAA from 2001 until 2011 where there seems to be a scaling presence of papers related to Semantic Web technologies especially from 2006. From 2011, the tendency continues with a significant number of papers related to LOD technologies that appear in panels related to data modelling, as for example the paper by Gruber et al. in 2012 'Linking Roman Coins: Current Work at the American Numismatic Society' within the section 'Data Modelling and sharing.' The big change seems to occur in 2014 when the need emerged to create a whole panel focused on ontological mapping under the title 'Ontologies and Standards.'[68] Most of the papers included were related to the development and expansion of an ontology and the difficulties encountered in mapping different datasets to bigger ontologies such as the CIDOC-CRM. The *Archives du sol (ArSol)*[69] was presented among other examples. The project provides access to archaeological data from different excavations by mapping their dataset to the CIDOC-CRM categories (Le Goff et al., 2014). An update of the same project was presented in the conference of the following year showing the accomplishments in the mapping of

67 https://arachne.dainst.org (accessed May 2020).
68 https://caa-international.org/proceedings/published/ (accessed May 2020).
69 http://arsol.univ-tours.fr/ (accessed May 2020).

ArSol data to CIDOC-CRM and the aim to query the *ArSol* data in SPARQL via the CIDOC-CRM (Marlet et al. 2015). The section on ontological modelling survived in the following editions until at least CAA 2018 with a session on ‘Islamic History and Archaeology: Linking Data and Ontologies’ (CAA proceedings 2018). The new session may suggest that LOD has now become an embedded theme in the conference, so that now it is possible to host different sessions on LOD within special domains.

Within the application of LOD technologies to archaeological research, the field of numismatics has been particularly prolific in the last decade, especially in the implementation of already-existing projects for the dissemination and interlinkage of different resources. In this field, several projects are developing ways to collect and integrate LOD with their databases to provide more powerful search engines that assist numismatic research (Granados 2019). *The Online Coins of the Roman Empire* (OCRE)[70] constitutes an open-access catalogue of Roman imperial coin types. The project applies the Linked Data approach to make available online a very large numismatic collection (Gruber et al. 2012). It is rooted in other famous numismatic projects such as *Numishare*, a software platform for managing numismatic data that supports linked data approaches, and the aforementioned *Nomisma*, a resource that establishes URIs for numismatic concepts. By the combination and implementation of these two resources, *OCRE* is being built as a tool to search and display Roman coinage. It can be used by field archaeologists to quickly identify coin types but, due to the application of LOD standards, it can also be used by big collections and institutions to retrieve metadata through the API, saving time in the data collection process. From a very similar perspective to that of the *OCRE* project, the *Digital Iconographic Atlas of Numismatics in Antiquity (DIANA)* is also interested in

70 http://numismatics.org/ocre/ (accessed May 2020).

the application of LOD technologies to allow its integration with other digital archives, with the aim to improve the diachronic study in numismatics. *DIANA* has been looking at ways to integrate *Pleiades* data in order to become a more powerful tool to represent the diachrony of coin types (Caltabiano et al., 2013). Another example worth mentioning is the *Kerameikos*[71] project. *Kerameikos* applies LOD technologies to the field of Greek pottery by developing a discipline-specific thesaurus to link existing vocabularies (Gruber et al., 2014). At the moment, the project is only focused on Greek pottery. However, the inclusion of Roman data could be a huge extension of the tool and hence a fundamental development for Roman archaeological research.

In the summer of 2019, the first panel entirely focused on Linked Data in the ancient world was accepted at the *FIEC / Classical Association Conference.*[72] The panel consisted of a series of short papers related to the application of Linked Data technologies to the study of the ancient world including *SNAP:DRGN, GODOT, Nomisma.org, Pelagios, Kerameikos* (and this thesis) and was followed by a thirty-minute joint discussion focused on the benefits of linking ancient world data and how to move research forward. One of the key topics that arose in the discussion was the main challenges faced by non-technical experts in the application of LOD technologies. The concerns raised included: lack of digital expertise and technical barriers, obstacles in the long-term maintenance and dissemination of the resources, the existence of repeated work and the quality and completeness of the data available online.

71 http://kerameikos.org/ (accessed May 2020).
72 https://www.fiec2019.org/sunday-7-july-2019/ (accessed May 2020).

Specific issues on the representativity of the resources available or the development of the data itself will be discussed in following chapters. Nevertheless, it is important to reflect on the more general challenges faced by scholars with non-technical expertise. Charlotte Tupman (forthcoming, section 2) has recently written about the obstacles found in the creation of LOD for epigraphic materials. She draws on the issues reported by the survey carried out by Beno et al. (2017) about the challenges faced in the publication of Open Data. The survey establishes three different categories: user-specific (portals, data quality and legal constraints), provider-specific (privacy and security, strategy and business and internal legal constraints) and those related to both user and provider (knowledge and experience) (Beno et al. 2017, 137). From these categories, Tupman considers those obstacles which can also be relevant to the publication of LOD in the field of epigraphy.

In the user-specific category, Tupman highlights the difficulties in browsing and searching, with special mention of the lack of information about the quality and maintenance of the data, the lack of documentation on how to use it and the uncertainty of legal or copyright constraints. In the provider-specific category, Tupman focusses on concerns derived from the loss of control over the released data, also connected to misrepresentation of the information or data which does not comply to the expected quality standards. In this category she also underlines the lack of resources and time and the difficulties in implementing LOD standards in the regular workflows (Tupman forthcoming, section 2). Within the last category, she focuses mainly on the lack of documentation and support that affects both providers and users. This issue was also raised by a survey conducted by the Association of European Research Libraries where all of the participants noted the necessity for specialist training, a question which also came out in the joint discussion carried out at the CA panel in 2019 as mentioned above. It seems that the lack of digital expertise and technical barriers are among the major concerns in the implementation of LOD technologies in the academic community. This question has been approached from different angles. Whereas the need for further documentation and training on digital skills is unanimous, certain approaches support the need for highly technical training including programming languages, the SPARQL querying language and other tools that facilitate the independence of the researcher at the time of implementing LOD technologies. Other perspectives, while acknowledging the benefits of this approach, also support the necessity to develop graphical user interfaces (GUI) that would facilitate the access of non-expert users to these technologies and therefore do not require the development of highly technical skills to access, query or reuse the data. This belief supports the idea that LOD will only become a reality when a strong community of users supports and attests to its application in a varied network of research projects supported institutionally and at a user level. This belief has motivated the development of more intuitive tools for the generation and implementation of LOD, such as *Recogito* and *Peripleo* mentioned above, and other specific developments that allow the querying of LOD without the necessity to learn SPARQL such as the search interface embedded in the ResearchSpace knowledge system (discussed below) or the possibilities explored in a session held in the Digital Humanities conference at Montreal in August 2017, 'Natural Language GUI for SPARQL' in the pre-conference workshop *Advancing Linked Open Data in the Humanities*.[73] The aim of the session was to reflect on ways to generate natural language SPARQL query interfaces for humanities scholars.

[73] https://voyant-tools.org/dtoc/?corpus=f294601c9d29d9ca41b050cdb7094143&docId=592ec814d5989c327ce5e399e82bbd97&curatorId=1501008131574.6355 (accessed June 2020).

Another important obstacle raised by Tupman is the sustainability of the data produced, which is also related to institutional support, agreements to collaborate, manageable time and financial costs, and engagement of users (Tupman forthcoming, section 2). The need for institutional-level protocols for the support of ongoing and future LOD research projects is fundamental to secure the long-term subsistence of not only LOD but any digital humanities projects. The inclusion of digital technologies in humanities disciplines has shifted the outcomes of research from bibliographic and textual resources to online repositories and datasets. This situation has motivated the change of institutional roles towards the sustainability of the information published online in portals and repositories that need to be maintained economically and editorially, safeguarding the quality of the data and its reliability. In cases in which institutional support is no longer a possibility, other potential solutions are raised in the field of community-driven alternatives that move from the institutional umbrella to community effort, an example of this is the *Pelagios Network* initiative mentioned above. This question also links to another of the issues raised by Tupman and discussed in the CA panel, the quality of the data published online and the incompleteness of the data. The concern about publishing incomplete corpora of data is still one of the main arguments raised in academia against the adoption of LOD standards. The fact that the data can be reused at an incomplete stage is not welcome, in most of the cases, by the data publishers. As Tupman considers, the issue in this regard, is not how to avoid incompleteness, which is always going to be a component, especially in archaeological research, but how to document and represent such incompleteness in a way that can be asserted and therefore potentially resolved in further contributions (Tupman forthcoming, section 2).

Finally, the question of dissemination of newly created resources and the promotion of LOD projects seems to have become an arising concern in the last decade. There is very little guidance available on how to promote and disseminate LOD projects online, and this issue becomes particularly alarming regarding LOD technologies and the Semantic Web, since one of the main requisites for its success relies on the interlinkage and collaboration between existing and newly created resources. Well-known initiatives for the promotion of LOD projects include the LOD cloud and the 'public-lod' mailing list. These facilitate communication and networking among researchers within the LOD community, however they were not created with the specific purpose of facilitating the promotion and leveraging of LOD implemented resources. The topic has not yet received sufficient attention from the linked data community, especially regarding published research or guidance on how better to leverage LOD resources and initiatives. In most cases, researchers draw on different media to promote projects with very different results. There is still the need to discuss efficiency of different strategies to raise awareness about LOD projects online, perhaps considering the development of a tentative corpus of best practices or recommendations to facilitate discoverability and alignment of new resources.

To summarise, the issues that seem to generate a major concern among researchers in the implementation of LOD technologies are mainly related to the lack of training and technical expertise, data sustainability, quality and incompleteness, promotion and leverage of new projects, and long-term sustainability of projects and data. Whilst this research does not offer specific solutions for any of these issues, it does offer insight into and documentation of the processes carried out in the generation, querying and analysis of both existing and newly generated datasets. The aim is that this summary will at least contribute to providing a new perspective into some of the manifested concerns.

4.5. Conclusions

This chapter has drawn on a variety of sources to illustrate the growth in activity in the Semantic Web over the last decades. Starting with a brief introduction to the concept of the Semantic Web, it has revised the current status of the LOD cloud and the different sectors in which LOD initiatives have emerged in recent years. The chapter then has provided an overview of the technologies that make the Semantic Web possible to achieve, with an examination of the application of LOD in archaeological projects and a discussion of main impediments faced by classicists in the application of LOD technologies.

The implementation of LOD technologies and their acceptance within the wider academic community is still limited and several projects acknowledge the challenges that the integration of LOD technologies poses, including the lack of technical expertise, the sustainability of the projects and the concerns regarding the quality and the completeness of the information published online. This situation supports the necessity for projects like this that can help to provide an assessment of the time and effort required for the implementation of LOD technologies in archaeological research and the benefits and limitations of the approach.

Chapter 5: Review of Resources

Overview:

Chapter 4 provided an introduction to the Semantic Web and the technologies and standards that make it possible, together with a discussion of the application of LOD technologies in archaeological projects and the impediments and concerns faced by non-technical users. This chapter focuses, first, on the question of consuming and publishing LOD and the protocols recommended to do so, and second, on a review of the existing LOD resources relevant for the study of early Roman Baetica. Following Berners-Lee's five-star criteria, the resources are surveyed and classified according to their compliance with LOD standards, including other applications that do not follow LOD recommendations but deliver relevant data for the case study. This review aims to take into account not only the proportion of resources available in LOD but also the degree to which these resources are capable of answering research questions.

5.1. Method

The procedure followed in this research includes three different steps as seen in Fig.5.1.

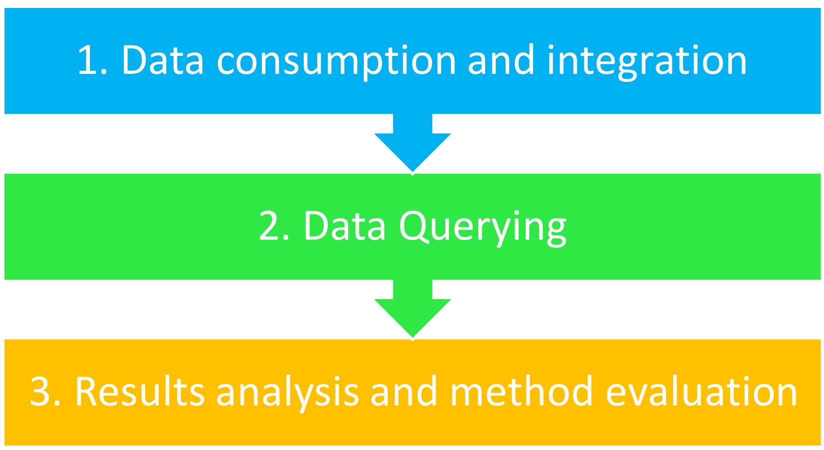

Fig. 5.1. Visualisation of the main procedure.

This chapter focuses on the process of identification and survey of relevant data types and data sources for this research, this being the first step of the first part of the methodology. This first part itself consists of five different stages that will be described in this and the following chapters (Fig. 5.2).

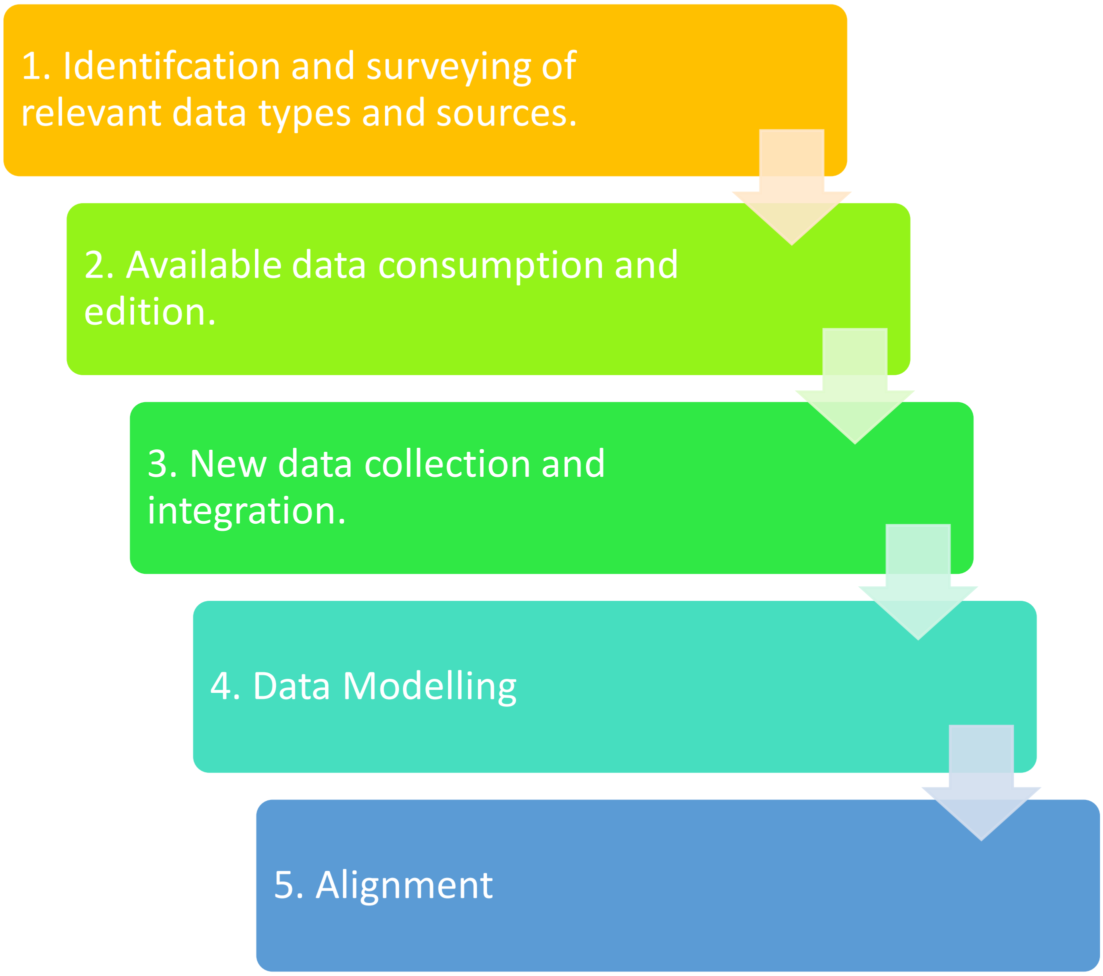

Fig. 5.2. Methodological steps for data consumption and integration.

Whereas Chapter 5 expands upon step 1: the exploration and surveying of the resources available online that this research consumes, Chapter 6 will focus on steps 2 to 4 which include the consumption of LOD online, the manual collection and integration of new data from the web and the manual collection of new data from relevant scholarship. Chapter 7 as the last part of the methodology, focuses on the generation of an ontology for data modelling and data alignment.

5.2. Publishing and consuming LOD

The Semantic Web consists of a 'Web of Data' in which information is published directly on the web and made available for users. In terms of consumption, one of the major benefits of LOD technologies is that they enable the collection of data without a priori knowledge of the schema or the content of the dataset (Rietveld 2016, 2). This, however, complicates the process for non-expert users.

In the standard Web, humans are considered as the consumers of the contents who rely on browsers to find relevant websites, then read the information, analyse it and come up with solutions to possible problems. This way of publishing information online can be done either directly in the Hypertext Mark-up Language (HTML) or using Content Management Systems (CMS). However, in the LOD ecosystem, the publication and consumption of data requires slightly different procedures. Software agents are considered as end-users and the content is published in the RDF data model, bringing some complexity to the process. RDF tools cannot assume general human intelligence in the user, so any inconsistencies or syntax errors may impede the information consumption (Rietveld 2016, 2-3). In the same way, whereas web pages use anchor tags to connect to each other, LOD uses URIs as stable identifiers to connect resources.

At present there is no robust 'general-purpose' Linked Data search service that allows the querying of several LOD sources at the same time to enhance the reutilisation of already-existing entities. It definitely has proven to be a necessity amongst researchers in specific domains, especially politics and science; however, a comprehensive service capable of satisfying all different needs has not yet been developed. New works on schema-level indexes occasionally emerge providing new insights into the question (see Gottron et al.

2013). However, most of the time the services become unavailable after relatively short periods of time probably because of the difficulties of keeping them up-to-date and running on a long-term basis. Services that have proved their efficacy in this research are:

1) FactForge: free and open-source service developed by Ontotext, a Semantic Web company, that allows cross search over a certain amount of resources without the need to provide an already-existing URI as the query parameter.[74]

2) SameAs.org: provides a similar service when having a URI to start the search with.[75]

3) Lodlive.it: a user-friendly SPARQL navigator that allows easy RDF browsing from DBpedia and Freebase.[76]

To be able to survey the linked data resources used in this research it is important to understand the process of data publication and collection and the services offered by the LOD applications, since the implementation of software agents to retrieve the information requires for a different toolkit to consume and produce LOD.

The first step for the publication of LOD involves the generation of a graph dataset in RDF format. The most common procedure is to convert into RDF an already-existing dataset coming from sources such as spreadsheets, CSV, JSON, KML and Web APIs. This can be done using programming languages such as Python or Java, but it can also be done using open-source applications such as Web-Karma, a tool that enables data integration following a provided data model.[77] Other resources are also available depending on the expertise of the user and the complexity of the data required.

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74 http://factfore.net; https://www.ontotext.com/the-company/ (accessed June 2020).
75 http://sameas.org/html (accessed June 2020).
76 http://en.lodlive.it/ (accessed June 2020).
77 https://github.com/usc-isi-i2/Web-Karma (accessed June 2020).

In order to model the domain, best practice would be to reuse already-existing ontologies to name the classes and properties extracted from the relations among the data in the spreadsheet. This is not always possible for very specific domains and so the extension of already-existing vocabularies or the generation of new ontologies is also an option. However, the design of an ontology is generally a complex collaborative endeavour that requires several years and a team of experts to be carried out (see section 4.3.3) Using already-existing ontologies makes it easier to align the data with accessible datasets. However, the use of new schemas should not be an impediment to this, since alignment with other ontologies and datasets can always be achieved through links embedded in the data (e.g., owl: sameAs). There are several tools available for ontology building. Protégé is an open-source ontology editor developed by researchers at Stanford University, which offers a user-friendly interface to reflect upon the building process, and an endpoint for SPARQL querying.[78] Another relevant service here is Linked Open Vocabularies (LOV).[79] The LOV dataset collects more than 650 RDFS vocabularies or OWL ontologies developed and used by datasets constituting the Linked Data Cloud and as such is a very useful tool to find existing vocabularies for a specific domain. Different methods for ontology-building procedure should also be considered and consulted before approaching the process.

Once the dataset is ready, the provider can publish it online. Generally speaking, a dataset is formed by the raw data itself, whereas a database can be the server where the data is hosted and the software or schema in which the data is organised and delivered. In LOD, every data record constitutes a triple, a set of triples constitutes a graph, and a set of graphs

78 https://protege.stanford.edu/ (accessed June 2020).
79 https://lov.linkeddata.es/dataset/lov/ (accessed June 2020).

constitutes the dataset. The data can be published either as Linked Open Data, which is publicly accessible online, or as Linked Data for private use, within a closed environment such as companies' or institutions' intranets. In the field of archaeology, the expectation is for data to be accessible, interoperable and reusable online. LOD protocols encourage the crediting of the data, although it is also fundamental to specify and provide clear licenses to ensure a wider and efficient re-use of the data. In this regard, best practice would require already widespread licenses such as Creative Commons, as recommended by The Cooperation for Open Data and Open Government Data (OGD). [80]

In the discipline of Digital Humanities, and especially in archaeology, one of the biggest impediments to LOD enabled research is that most data are still not freely accessible online. Legacy databases and similar silos do not allow open access to the information, hindering its discoverability and reusability. It is at this point that Open Access becomes a fundamental requirement for research. The way in which LOD works requires the information to be available and freely accessible, from the very raw data in which the research is based to the final research output (i.e., publication).

Nevertheless, open repositories are not the only option to host data online. It is also possible to build general-user interfaces to provide easy access to the data and boost its consumption among end-users. Within the domain of Linked Ancient World Data (LAWD), [81] several applications allow easy access and retrieval of information, such as SNAP:DRGN or Standard for Networking Ancient Prosopographies: Data and Relations

[80] For more information about Creative Commons licenses and licensing considerations see https://creativecommons.org/ (accessed June 2020).

[81] The Linked Ancient World Data refers to all data generated and published online following LOD standards and within the scope of the ancient Mediterranean and the ancient Near East.

in Graeco-Roman Names (Bodard et al. 2017).[82] This links together large collections of ancient person data (e.g., names, person-like entities, dates) managed in heterogenous systems and formats. By combining these different data sources into one single user interface, SNAP allows the querying and downloading of data.

Laurens Rietveld (2016, 4-5) classifies the publication of LOD into three different methods:

a. The most common is to host an RDF version of the dataset online, a very simple system that only requires a file webserver. The disadvantage of this method is that it requires a bigger effort from the user since it is not possible to retrieve single files from the dataset, only by using an RDF parser over the data or downloading it into a local triple store and querying it locally.
b. The second method is using dereferenceable URIs that can also be available in a human-readable form.[83] Data can be collected as static files on a server or accessed dynamically through, e.g., a SPARQL endpoint such as LOV vocabularies.
c. The third method involves the publication of SPARQL endpoints directly. This is the most useful solution for Linked Data providers who lack information about consumers' needs. Nevertheless, hosting SPARQL endpoints requires highly availability of memory, CPU processing power and disc space, thus limiting the amount of publicly available SPARQL endpoints.

Nevertheless, the publication of LOD does not make sense if the data is not going to be consumed. In the last five years, a large number of new knowledge resources have been

[82] For more information about SNAP: DRGN see https://snapdrgn.net/about (accessed June 2020).
[83] See for example https://edh-www.adw.uni-heidelberg.de/edh/inschrift/HD000912 (accessed June 2020).

incorporated into the Semantic Web. Yet, despite this growth, it still remains difficult for the user to consume information from this 'Web of Data'. Whereas much effort has been put into the publication of new datasets and the insertion of these in the LOD world, less attention has been paid to the challenges encountered by the consumer, mostly related to the fragmentary and inconsistent nature of the 'Web of Data'. One of the main difficulties is the consumption of multiple Linked Data sources, a difficulty that is seldom discussed in the literature. The documentation tends to consider the consumption of data from only one dataset or specific resources, a practice that enhances the accessibility of the data but neglects wider benefits such as data integration and interoperability (Millard et al., 2010, 2).

The consumption of LOD requires a standard protocol to be able to extract the data from a relevant Web resource and to answer a relevant question. Baer and Kaltenbök (2010, 36) propose a series of stages that I summarise and expand here for their significance to my methodology:

1. Definition of a specific research question: there is a lot of information within the LOD Cloud, so, before starting data collection, it is important to have a specific use case in mind.
2. Research regarding the data resources available within the specific domain and a survey of the quality of the data hosted by these resources considering curating and updating procedures.
3. Establishment of consumption protocols: these protocols should specify what data is going to be re-used and from what source.

4. Alignment among datasets: the matching of different vocabularies is necessary to guarantee the easy integration of data and the leverage of all the benefits of LOD.

Within the execution of this protocol several challenges can emerge. Among these challenges, Millard et al. (2010) have identified 'co-referentiation' and 'ontology mapping' as two of the most common. Co-referentiation refers to the problem of reduplication of Unique Resource Identifiers (URIs). Whereas one would think that these resources are unique, as their name denotes, in fact they are very often reduplicated every time a new application or dataset comes out. It is theoretically possible for data providers to use unique URIs to represent objects globally; nevertheless, it is not always viable. For many data providers, it is time-consuming to look for 'the most commonly used' URIs for the concepts they are describing and so in most of the cases they mint their own URIs (Millard et al. 2010, p.2). In addition, many data resources are created on already-existing datasets using internal IDs, so they at most cross-link to equivalent resources in other databases. The minting of new URIs is also a matter related to funding and business interests, since those projects that use already-existing URIs are less likely to be considered to have produced an 'original product' and concerns of 'ownership' of the data are also considered.

The other issue is ontology mapping. In a manner similar to the way users mint new URIs, the generation of new ontologies is a common practice amongst new projects. Despite the fact that LOD technologies allow cross-referencing across multiple resources, ontology building has also turned into an expected practice when new LOD datasets are developed. As Millard et al. (2010, 3) have noted, this practice might well improve over time when particular ontologies become more commonly used and gain popularity in specific domains. Nevertheless, it is expected that common concepts (e.g., people and places) will remain described in several ways.

As explained above, LOD was conceived to be consumed online without the need to collect data locally. One of the best ways to explore the potential of this is through so-called ‘federated queries.’ These constitute the optimal approach by allowing access to several repositories at the same time through a single SPARQL endpoint. Nevertheless, federated queries can also be problematic, the solely online access of the data can be very challenging if the web connection fails or the database is undergoing some updating process; furthermore, federated queries can be very challenging for several reasons.

The simplest reasons why federation may not work could be related to the temporary unavailability of certain endpoints and the limitation of results obtained to a specific number of records. However, in certain cases, federated queries are simply not allowed. When SPARQL endpoints allow service clauses (the sort of clauses needed to call other endpoints in federated queries), they allow anyone to use their query engine and associated CPU power to compute solutions from queries to other datasets. Because of this, some data providers are not inclined to share their CPU power to process data from other providers. In these cases, the best solution is to use an endpoint that supports federated queries, but if the aim is to query multiple endpoints, the best approach might be to run a local endpoint. This can be very simple as it will not need to contain any actual data, but to allow federation for the user. In any case, the failure of one single endpoint can either reduce the query solution (if the service clause is specified to be SILENT, i.e., fault-tolerant to an extent), or cause the breakdown of the whole process altogether. Hence, in order to avoid problems like these and to facilitate offline research, I have generated a database hosted on a local triplestore to allocate the data collected online from the resources surveyed here and new data generated ex-novo – within the scope of cultural interaction – therefore boosting both the consumption of LOD from the web and the understanding of the LOD production process.

5.3. LOD resources for the study of early Roman Spain

Recent archaeological research on the Roman colonisation of Spain is producing significant amounts of data that need to be processed and analysed at an ever-growing scale. Archaeologists keep looking for new systems to collect, store and analyse the information they obtain and publish online in the form of obscure journals or non-functional databases, most of which is still decontextualised. The implementation of LOD technologies to ancient-world studies has motivated the reformulation of traditional views and inspired new questions.

The study of archaeological evidence in the context of Roman colonisation in the west has benefited a great deal from these new tools. New databases focused on the Roman world are now starting to make available large amounts of data coming from various institutions, leading to a burgeoning of new interrogations and studies that rely on digital technologies. The number of databases collecting information on the Roman province of Hispania is also continuously increasing. These online datasets give the researcher the opportunity to access, compile and share a vast amount of information that would be difficult to access otherwise.

In this section I review a series of resources relevant to this case study that are available as LOD or can be integrated as LOD. The resources are classified into two different groups: international and Spanish resources. This is useful because there seems to be a big difference between both categories and the results obtained from analyzing all resources together would not provide representative results. I consider 'Spanish' any resource that conforms to any of these three requirements: a) has been produced in Spain; b) has been produced by a team of Spanish scholars; c) has received funding from the Spanish government. Any other resources will be included in the international resources section. Within each of these sections, I have divided the resources according to their typology and main features into three different groups: a) Gazetteers, b) Databases, c) Collaborative Projects. The resources are surveyed according to the type of data they can provide, the difficulties in data collection and their compliance with LOD standards.

5.3.1. International Resources

Resource	*Type*	*URL*	*Available in Open Access*	*Machine readable structured data*	*Non-proprietary format*	*W3C Recommendations*	*Links to similar resources*
Pleiades	**GAZETEERS**	https://pleiades.stoa.org/	★	★	★	★	★
DARE		https://imperium.ahlfeldt.se/	★	★	★	★	★
TM Places		http://www.trismegistos.org	★	★	★	★	★
EDH	**DATABASES**	http://edh-www.adw.uni-heidelberg.de/	★	★	★	★	★
ResearchSpace		https://public.researchspace.org/resource/Start	★	★	★	★	
Arachne		https://arachne.dainst.org	★	★	★	★	
Nomisma	**COLLABORATIVE PROJECTS**	http://nomisma.org/	★	★	★	★	★
Pelagios		http://commons.pelagios.org/	★	★	★	★	★

Table. 5.1. Classification of international resources.

Green shows total compliance with Berners-Lee five-stars criterion, orange partial compliance, and red the least.

5.3.1.1 Gazetteers

Ancient Greek gazetteers have existed since the Hellenistic era. They constitute geographical dictionaries of places that can also collect other type of information such as population, dimensions, alternative names or location. In classical research, gazetteers are commonly used together with maps and atlases. Within the Semantic Web ecosystem, gazetteers play a fundamental role in the interconnection of resources based on common references to place. Three different gazetteers have been considered in this research as seen in Table 5.1: *Pleiades*, *DARE* and the *Trismegistos* database of places.

The *Pleiades Gazetteer of the Ancient World* was developed at the Institute for the Study of the Ancient World (ISAW), New York University. The project was first conceived as an online community-driven version of the *Barrington Atlas of the Greek and Roman World* implemented with stable URIs for each of the entries and allowing other projects to retrieve information computationally and use *Pleiades* as a connection between non-related projects (Isaksen et al. 2014; Elliot/Gilles 2009).

Pleiades permits users to search places by name. Historical place names are grouped into categories that include precise names with confirmed coordinates, places with uncertain positions or places with unknown exact location. As of July 2020, *Pleiades* includes 37,197 ancient places, 33,039 ancient names and 40,239 locations. From the *Pleiades* record of Osuna (the ancient town of Urso during the Iberian period of Ulterior-Baetica later known as Colonia Genitiva Iulia), complete records in *Pleiades* include, first, the assigned canonical URI for the resource (https://pleiades.stoa.org/places/256503) interactive maps, geographical coordinates (e.g., 37.246621, -5.099275), alternative names with chronological attestations, for example "Osuna (Spanish modern)" and

"Colonia Genitiva Iulia (330BC —AD 640)", connections between the place and the province or other records, place type for example "settlement", links to classical and modern references, initial provenance and further details, alternative representations of the data, suggested citation, and, most importantly, links to related applications that also provide LOD about the place itself such as Trismegistos[84] and DARE[85] (Fig. 5.3).

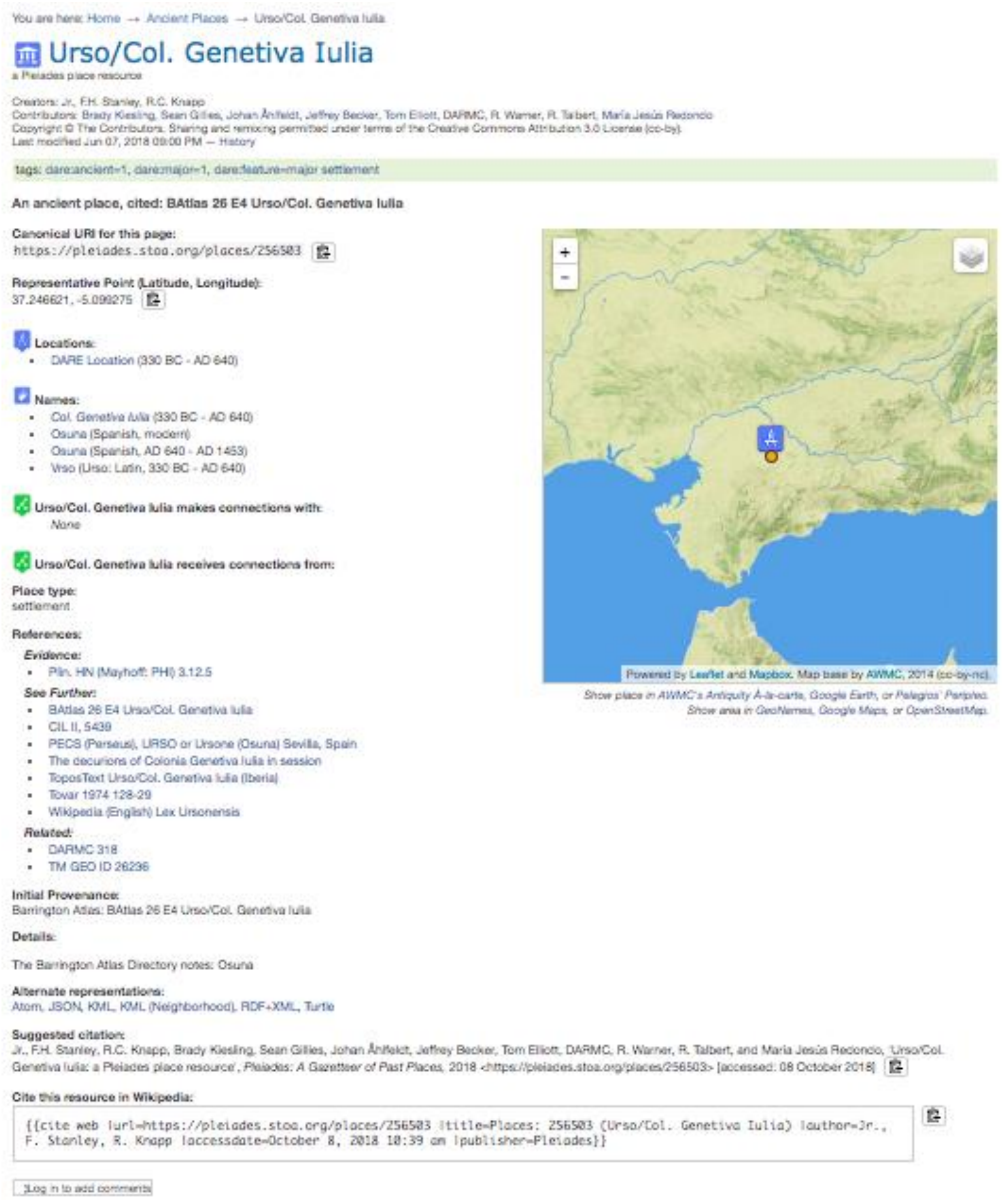

Fig. 5.3. Pleiades entry for the resource 'Osuna' (pleaides:256503) *(accessed June 2020).*

84 https://www.trismegistos.org/ (accessed June 2020).
85 https://imperium.ahlfeldt.se/ (accessed June 2020).

The resource is available on the Web together with images and text that may be downloaded and reused under a Creative Commons Attribution license (CC-BY). The records are provided as machine-readable structured data in several formats including Altom, JSON, KML, KML (neighbourhood), RDF+XML and Turtle. The data includes links to other resources such as Trismegistos and DARE. In terms of LOD, the only recommendation with which *Pleiades* does not comply with is the publication of an SPARQL endpoint to allow the querying of the data. Because of this, exports of specific sets of data or filtered RDF, e.g., all the records from Hispania-Ulterior-Baetica, are not enabled, so the user will need to download the whole dataset or individual records from the resource interface to be queried internally. This would not be a problem for a small project, but might be for a larger enterprise. If the user is not interested in exporting the whole dataset nor in downloading each of the records individually, a solution could be to write a script to go to each of the individual URIs of the places selected and extract the data required.

Pleiades' RDF uses concepts from different vocabularies and ontologies, some of which include: The Citation Ontology to identify the works cited and their context; Dublin core for the metadata about the records; FOAF ontology for content creators and contributors; GeoVocab to express geographic connections; Ordnance Survey Ontology for the extents of spatial objects and overlap and OWL to identify and resolve duplicates within the dataset. To this one should add *Pleiades*' own RDF vocabulary consisting of three main classes (`pleiades:Place`, `pleiades:Location` and `pleiades:Name`)[86]. For the development of the dataset, 209 records referring to places in Hispania-Ulterior-Baetica

[86] For more information on Pleiades' vocabularies and RDF data, visit https://github.com/isawnyu/pleiades-rdf/blob/master/README.rst (accessed June 2020).

have been extracted individually from Pleiades after confirming that the information provided was correct. Whereas the information provided by Pleiades is very complete, there seems to be certain inaccuracy especially in the time periods for some of the settlements which were initially attributed from the Barrington Atlas and some incompleteness of the information especially regarding the different juridical status of the settlements that during Roman occupation evolve from *oppidum*, to *municipium* and *colonia*. Pleiades offers the different names given to a place, and different timespan attributed to them, but there is a lack of information on when or why these changes occurred.[87] Other examples of Spanish resources, such as CVB as will be discussed in the next section, have tried to overcome this deficiency by providing more information about the history of the place and its context.

Similar issues to those seen in Pleiades have come up in regard to the data provided by DARE. The *Digital Atlas of the Roman Empire (DARE)* is one of the resources which link to *Pleiades* and vice versa. DARE is a Geographical Information System (GIS) which was developed over a map of the Roman Empire created in 2012 by Johan Åhlfeldt at the Department of Archaeology and Ancient History of the University of Lund in collaboration with the Pelagios project. Based on a similar philosophy to that of *Pleiades*, *DARE* displays a higher level of accuracy drawing on digital resources such as satellite imagery, national topographic maps, classical sources and scholarly literature. One of *DARE's* latest updates is the addition of 9,111 sites with different provenances from those collected in the Barrington Atlas, harvested from national heritage databases such as the UK-based heritage databases *Pastscape* and *Canmore*.[88] *DARE's* base map can be reused

[87] This issue is further discussed in chapter 6 and some possible solutions are discussed.

[88] https://www.pastscape.org.uk/ ; https://canmore.org.uk/ (accessed June 2020).

under a Creative Commons BY-SA license and is employed by *Pelagios Commons* and *Pleiades* to provide historical context to their mapping applications.

DARE's gazetteer is implemented in the Pelagios project and ancient places are classified as places or buildings (subsites) with individual place types and locations. In relation to places within Ulterior-Baetica, *DARE* has proved to present a much more detailed database including minor sites not so commonly shown in other resources. Despite the geographic dataset seeming to be richer, the assignation of date periods for settlements is a bit problematic. The system followed is by period assignment according to the Barrington Atlas. For places in Ulterior-Baetica, the time periods seem to correspond to three timespans:

a) 750 BCE-640 CE for Phoenician or Punic settlements,

b) 330 BCE-300/640 CE for settlements occupied later, and

c) 30B CE-300/640CE for the newest sites.

While these general timespans help to acquire a general view of the occupation of the area and the period in which the first settlements may have taken place, in specific cases the assignation of timespans is not accurate enough. For example, we know from the archaeological record in Gades (Cádiz) that the city was founded by Tyrian communities around the 8th century BCE and the first Roman settlements in the area date to 100 BCE and run over four centuries until 300 CE when Roman installations seem to fall into disuse, therefore not quite corresponding with the DARE date range between 750 BCE and 640 CE, as shown in Fig. 5.4. Examples like this can also be found in Pleiades, where in some cases the information provided is not incorrect, but it either is incomplete, or it has been produced from general statements, and therefore lacks accuracy in specific cases. This consideration should be taken into account at the time of access, to assess the validity of the data provided by the resource. Examples like this suggest that data ingested from high-volume datasets should be managed carefully and interrogated to make sure all the information is of high enough quality to support research questions. In those cases, in which the information is incomplete or wrong, the data should be edited and corrected if possible, and the changes communicated to the source dataset. Examples for potential corrections of Linked Open Data ingested from the LOD cloud are presented in Chapter 5.

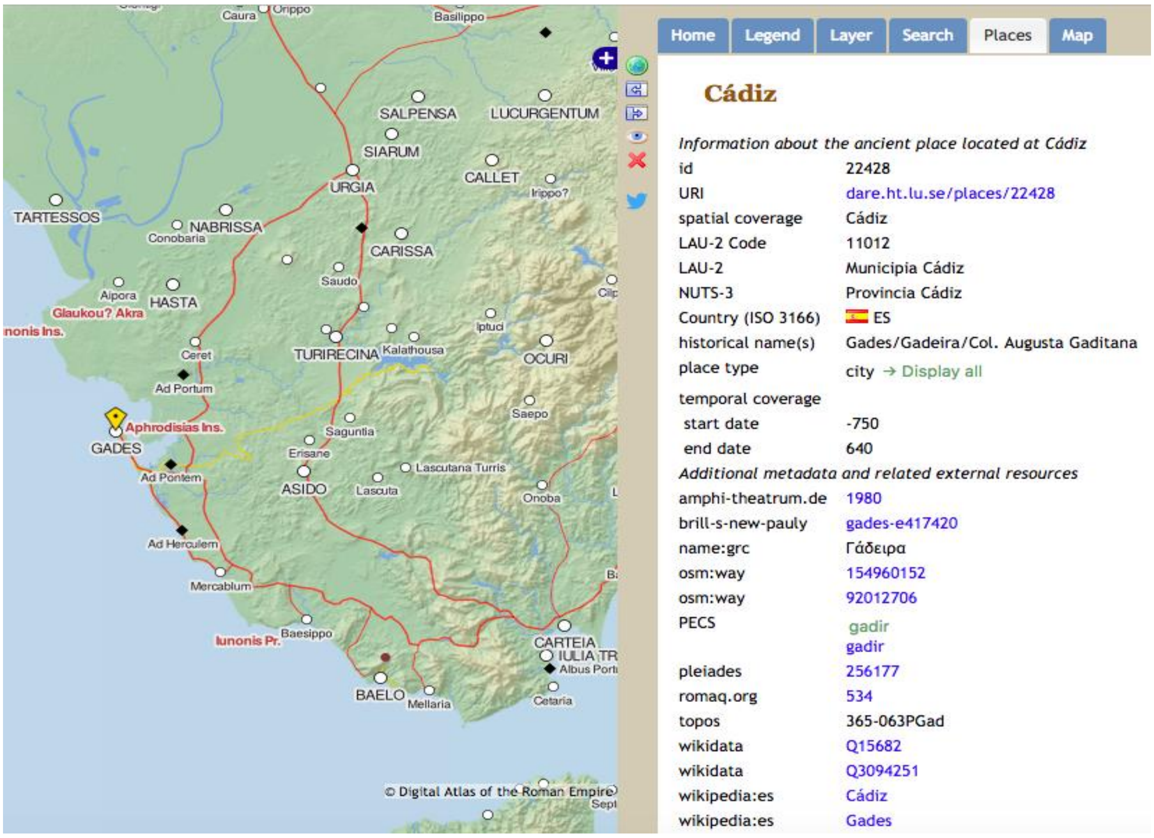

Fig. 5.4. DARE entry for Cádiz (dare:22428) (accessed June 2020).

In accordance with the LOD five-star standard, *DARE* is available on the web under a Creative Commons Attribution license. The records are provided as machine-readable structured data in several formats including RDF, XML text and Turtle providing links to other resources such as *Pelagios, Pleiades* and *Wikidata*. As with *Pleiades, DARE* does not provide a SPARQL endpoint to query for specific records. Despite the lack of a

SPARQL endpoint, *DARE* does provide a web API with easy instructions to follow. Through the API it is possible to list all the places from a specific geographical area and then use a script to obtain the RDF data from those places. The script opens each of the URIs provided for the specific places, then parses the RDF and converts it into individual documents for each of the records. This method was followed to extract 209 RDF records. Nevertheless, although the RDF is provided, the downloaded data regarding places within Ulterior-Baetica have revealed certain inconsistencies in the serialisation of the RDF, which prevented the parsing.

Gazetteers can be used as resources in themselves, as in the case of *Pleiades* or *DARE*, but they can also be hosted within other larger resources to disambiguate the geographical places contained in their databases, as in the case of *Trismegistos Places*. *Trismegistos* (TM) was initially configured as a database of metadata about published papyrological documents from Graeco-Roman Egypt, but it was soon expanded by the addition of epigraphic materials, and the broadening of the chronological and geographical scope. *TM* is now a large platform that compiles different data about texts, collections, archives, people, networks and places. *TM Places* consists of 52567 ancient and modern places to some extent connected to the ancient world. From Ulterior-Baetica, it includes a large number of settlements most of which include metadata about the inscriptions found there and the epigraphy that refers to those specific locations, as can be seen in Fig. 5.5.

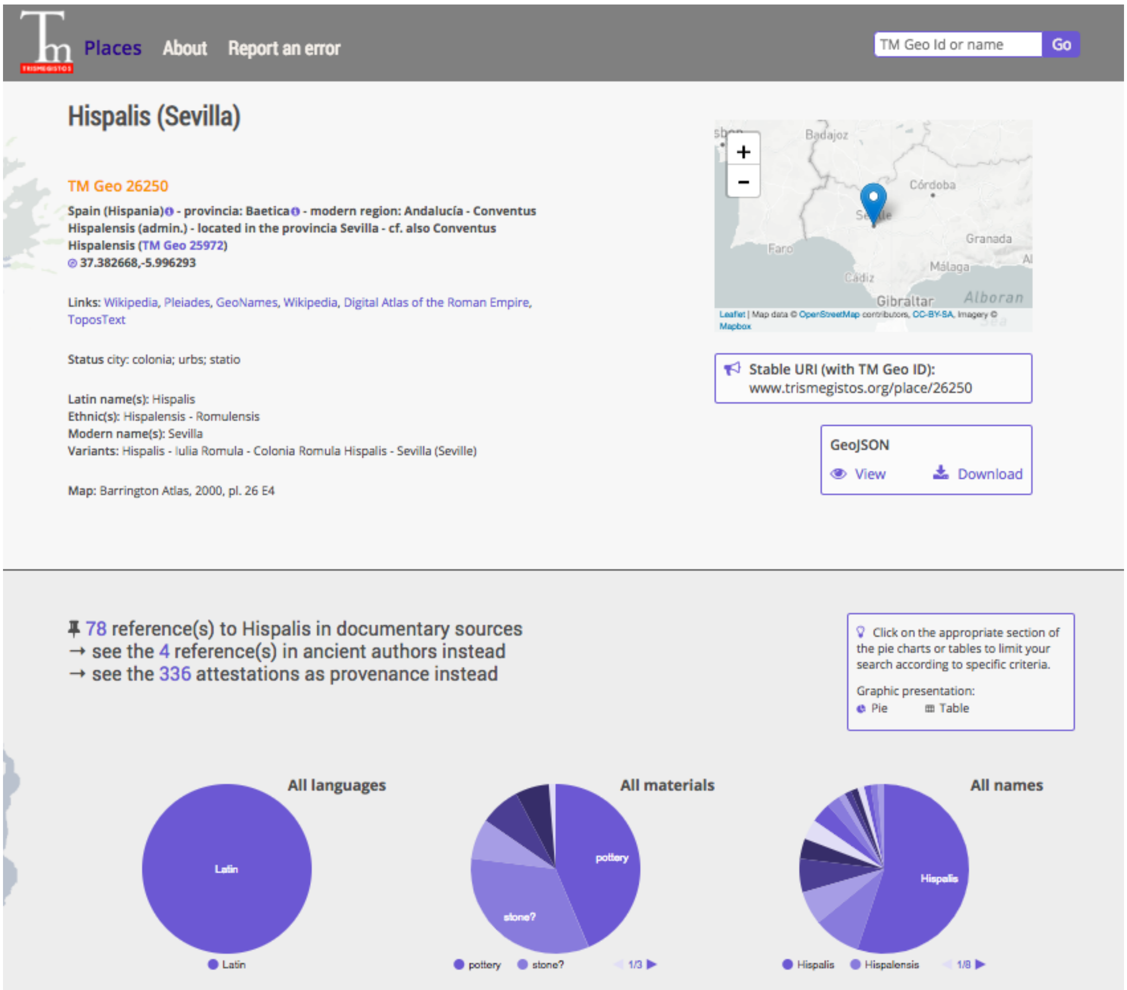

Fig. 5.5. TM Places entry for 'Hispalis' (tm:26250) (accessed June 2020).

The user can obtain metadata about the place and also statistical analysis about textual sources regarding material, language and attested names. This can be quite useful to run analysis about the textual evidence from the province. Although *Trismegistos* is not a Linked Open Database per se, it does provide stable URIs for each of the places together with relevant metadata, links to the text and further information collected in Trismegistos as well as links to partner resources such as *Pleiades* or the *Epigraphic Database of Heidelberg* (EDH).[89] Because of this, links to the TM Places record have been integrated within the Ulterior-Baetica dataset. *TM Places* provides data downloads in JSON-LD. In

[89] For EDH see https://edh-www.adw.uni-heidelberg.de/home (accessed June 2020).

the same way, it provides neither a SPARQL endpoint nor a web API, but despite it not being a strictly LOD database it does comply with specific standards that make it easy to be integrated and referenced with other LOD datasets.

5.3.1.2. Databases

The databases used for the collection of data relevant to Ulterior-Baetica in this research are *EDH*, the British Museum semantic dataset, and Arachne.Idai.

The *Epigraphic Database Heidelberg (EDH)* is one of the first epigraphic collections that recognised the importance of establishing connections between different resources and embraced the implementations proposed by LOD technologies. *EDH* was founded in 1986 by Géza Alföldy for the registration and collection of ancient Roman inscriptions together with an epigraphic bibliography and a photographic archive. *EDH* constitutes one of the leading epigraphic databases of Latin and bilingual inscriptions from the western provinces of the Roman world and partners with the *Electronic Archive of Greek and Latin Epigraphy (EAGLE), The Europeana network of Ancient Greek and Latin Epigraphy (EAGLE) and Pelagios Commons*. *EDH* offers a varied range of inscriptions from the Iberian Peninsula and a large dataset from the province of Baetica, a sample of which is shown below (Fig. 5.6).

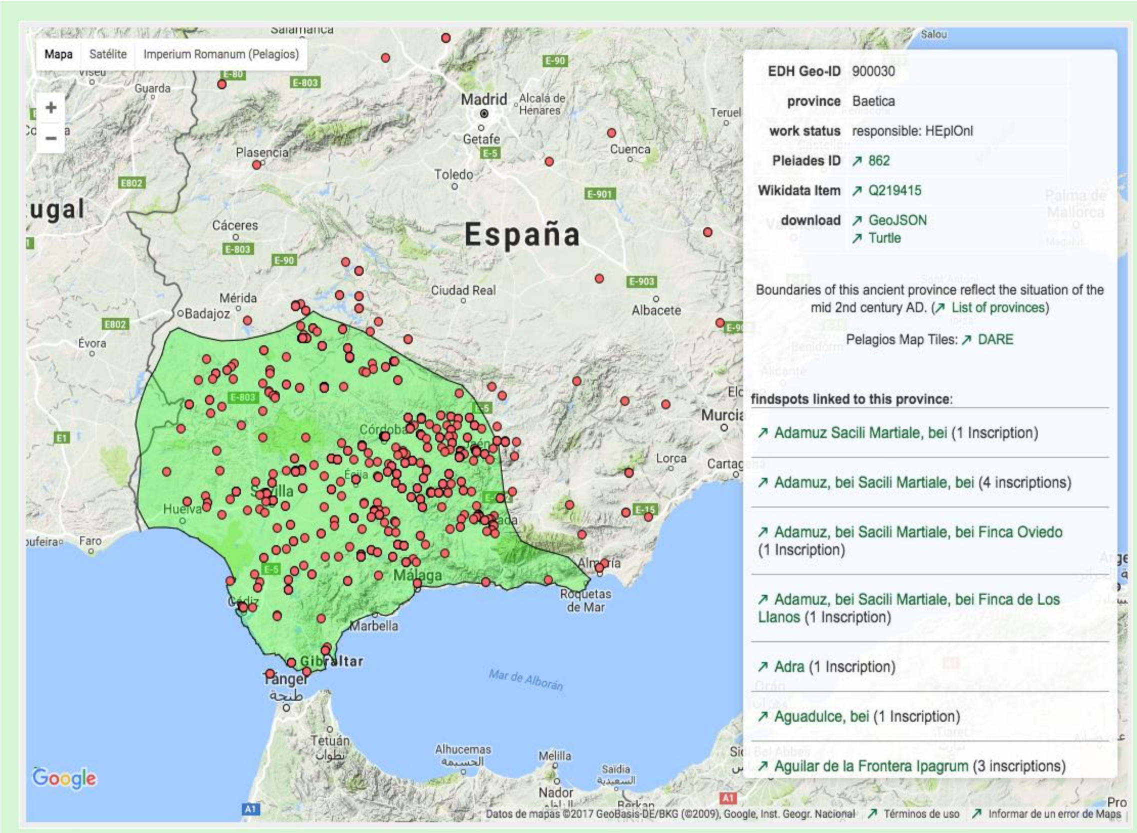

Fig. 5.6. Screenshot for the query for ‘Baetica’ (EDH) (accessed June 2020).

EDH consists of several specific databases focused on epigraphy, photography, bibliography and geographical places and establishes links with some of the main European epigraphic resources such as Trismegistos Texts, Hispania Epigraphica (in the case of the Spanish inscriptions) and Epigraphik-Datenbank Clauss Slaby. In addition to the web application, EDH is one of the resources that most closely follow the W3C recommendations in terms of LOD standards. EDH has recently made available a data repository that allows and encourages the downloads of the data both individually for each of the records through their individuals URIs (in XML, JSON) or by extracting large sections of the dataset, either through a bulk download of the RDF data[90] or through the

90 https://edh-www.adw.uni-heidelberg.de/export (accessed June 2020).

web API[91] where the user can query the data for province, country, findspot etc. The API provides extended instructions and responses are provided in JSON format.

Frank Grieshaber (2019) has recently published a guide on how to approach and reuse EDH data as LOD and other formats. Grieshaber notes the many requests from scholars to have access to the EDH dataset that motivated the publication of the Open Data Repository. The guide includes a section on the SPARQL endpoint provided by EDH where users can run queries on specific features with a varied response format including text, JSON, XML, CSV and TSV. Before writing queries on the SPARQL endpoint, it is recommended to become familiar with the data, running some exploratory queries or reading through the data itself. *EDH'*s RDF uses several vocabularies such as RDF, RDFs, LAWD, FOAF and the Nomisma ontology. All the data can be reused under a CC BY-CA-SA 4.0 license. Data dumps of *EDH* have also been integrated into the Ulterior-Baetica local dataset generated in this investigation (see next chapter).

The RDF provided is still an incomplete beta version, and there is still some experimentation underway regarding the data modelling (Grieshaber 2019, 10). This again brings the concern on the character of the data modelled and the extent to which resources such as EDH can provide evidence of enough quality to address research questions and support research conclusions. In this case, as noted, the RDF is still in a beta version especially in regard to the modelling of the data, which does not cover all the features of the original source. Whereas the concerns discussed with *Pleiades* and *DARE* focused more on the inaccuracies of the data sometimes shaped by the overly general statements used in the production of the information, in this case, the issue refers

91 https://edh-www.adw.uni-heidelberg.de/data/api (accessed June 2020).

to a common concern in LOD, which is the incompleteness of the information. This issue has also been discussed in Chapter 4 noted by Tupman (forthcoming) and Beno et al. (2017). As Tupman considers ‘the question of incompleteness is certainly an unconfortable issue when dealing with data but is not an alien concern especially for epigraphers and archaeologists and it does not invalidate the full enterprise’ (Tupman forthcoming, section 2). It is important to understand that LOD is still a work in progress that will keep improving and being validated over time with the further contributions both in terms of research and resources developed. The fact that the data is not complete does not invalidate the research process or the conclusions obtained, but it does otherwise open new lines of discussion that will influence and enrich future development of the existing projects.

While *EDH* was making its data available online, another significant resource for the study of archaeological collections was simultaneously being developed, the *British Museum semantic database* and the *ResearchSpace* knowledge system. The BM is the first UK arts organisation to instigate a Semantic Web version of its collection data. The new service brings the British Museum into the LOD environment and allows software developers to produce their own applications that can directly manipulate and reuse the data. Furthermore, it allows researchers and scholars to query the data unambiguously and enable automatic updates.

The semantically enhanced database of the British Museum applies the International Committee for Documentation Conceptual Reference Model (CIDOC-CRM). This ontology delivers the terminology to describe implicit and explicit relationships in cultural heritage documentation. The main aim of CIDOC-CRM is to enable a common framework to which any cultural heritage dataset can be mapped. As noted above, the possibility to generate a data structure that can be used in any information management system in the cultural heritage field could be a fundamental step in information interchange to mediate among the different data sources across institutional and geographical boundaries. Nevertheless, the use of CIDOC-CRM has not yet been adopted by all information sources, mainly due to its complexity. Projects such as SNAP-DRAGN or Nomisma.org have opted for simpler resource-tailored models which allow larger flexibility and make data easier to share among datasets (Bodard et. al. 2017, 35). Another approach in this regard has been taken by Linked.Art, a project that aims to generate a usable CRM-derived vocabulary in JSON-LD, in which one of the outputs is a CIDOC-CRM class analysis including overly specific or ineffective classes. [92]

The semantic version of the BM collection is available through two different platforms: the BM SPARQL endpoint together with example queries, [93] and the *ResearchSpace* knowledge system, a system that allows users with no previous expertise in SPARQL to query the database. [94] This platform constitutes a prototype project to avoid accessibility problems to Linked Data for non-expert users especially those derived from SPARQL querying. The prototype enables navigation over the dataset and the development of complex queries by answering a series of questions in the interface. By using this 'follow your nose' system, the user does not need to know the SPARQL querying language and the accessibility of the dataset is therefore much better. The results of the queries are displayed either in charts or tables that provide URIs of the resulting records. These URIs display the information about the object in HTML including the CIDOC properties related

92 https://linked.art/. For more information, see https://linked.art/model/profile/class_analysis.html (accessed June 2020).
93 https://collection.britishmuseum.org/sparql (accessed June 2020).
94 https://public.researchspace.org/resource/Start (accessed June 2020).

to that object. This constitutes an important innovation in facilitating access of non-technical researchers to Linked Data and therefore its consumption. Nevertheless, ResearchSpace does not allow the individual or bulk download of the RDF and the URIs for the records are obscure, only accessible when decoded from the URL of the human-redeable version (Fig. 5.7). Furthermore, the user should take into account that the data provided by ResearchSpace is that compiled by the British Museum collections, therefore, although the resource and the standards promoted (URIs, querying, vocabularies) are quite relevant for this case study, the data is not as relevant as that provided by other Spanish collections.

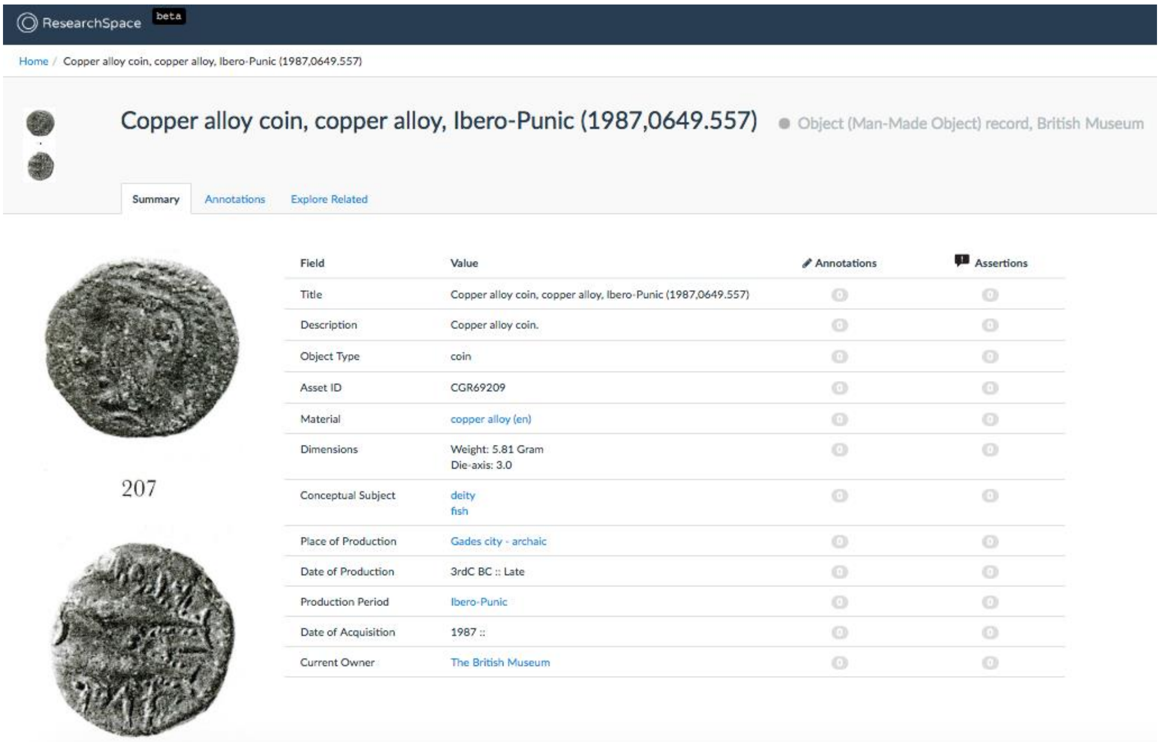

Fig. 5.7. Coin modelled in ResearchSpace (BM collections online CGR69209) (accessed June 2020).

An ongoing cooperative project aims to map the *Arachne* archaeology database to CIDOC-CRM (Binding et al. 2008). iDAI.objects *Arachne* is the object database of the German Archaeological Institute, a research tool that provides access to archaeological objects in several different datasets. Its main objectives are, first, the interoperability among different resources, and second, to ensure the preservation of archival material either digitised or born digitally.

Arachne is advertised as employing Semantic Web strategies. Nevertheless, these are not that obvious when navigating the database. It provides URIs for all the objects digitally presented but it does not provide RDF or a SPARQL endpoint to query the data. The information can be accessed through individual queries using the interface browser as seen in Fig 5.8., or the API which provides JSON. Despite this, the URIs provided by *Arachne* can deliver stable identifiers for objects in archaeological datasets, which is a good way to reuse already-existing URIs to identify specific pieces.

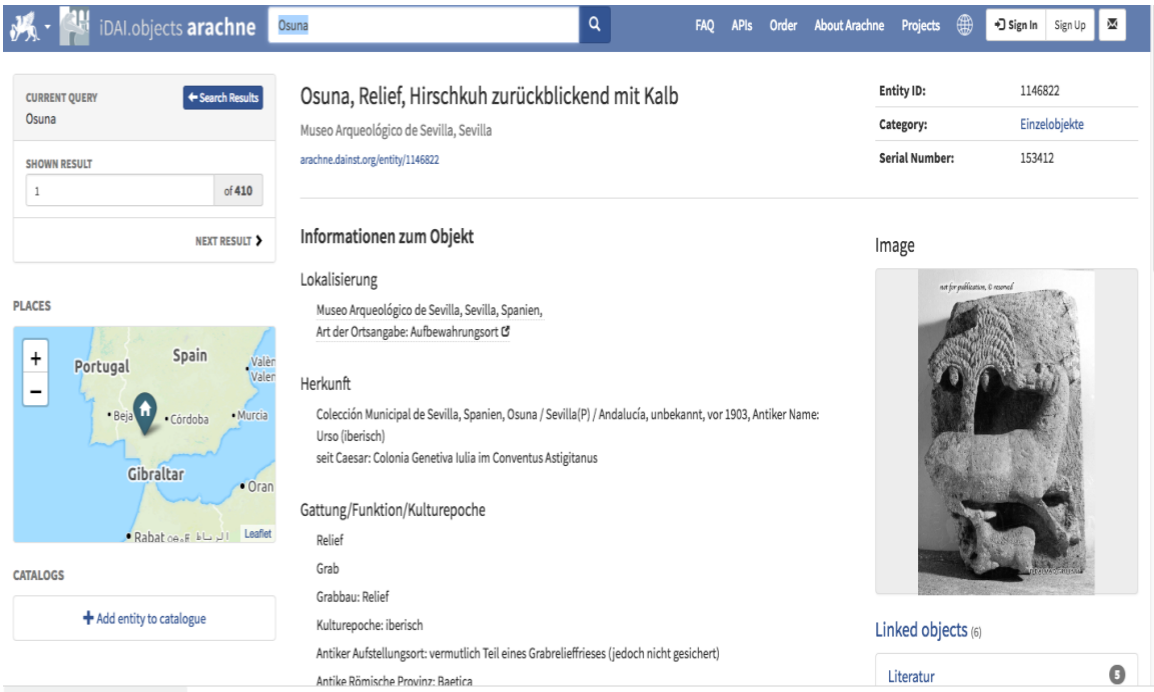

Fig. 5.8. Relief from Osuna in the Arachne database (arachne:1146822) (accessed June 2020).

5.3.1.3. Collaborative projects.

Apart from gazetteers and databases, this research relies upon a third type of resource that I have called collaborative projects. These resources not only provide a way to access different databases from one single browser, but also develop community-driven efforts to interweave different projects within a similar objective and philosophy. Examples of this are *Nomisma.org* and *Pelagios Commons*.

Numismatics.org is the main domain for numismatic research data online encompassing several projects, all of them hosted by the American Numismatic Society (ANS). The objective of the ANS is to make available worldwide significant numismatic corpora that have traditionally been difficult to access, as they were only available through libraries or archives because of their dimensions and prices (e.g., *Coins of the Roman Republic* or *the Roman Republic Coinage*). *Nomisma* is one of these resources; it provides URIs for numismatic concepts together with reusable RDF that links to similar data repositories. Instead of relying on text strings for the definition of controlled vocabularies, *Nomisma* uses URIs accessible online through the HTTP protocol, so that when the URIs are dereferenced by HTTP, either using a browser (for humans) or an automated process (by computers) the data is provided in both versions (Gruber 2018, 2). The HTML version of the data provides information about the concept, multilingual labels for the same denomination and other URIs in parallel to LOD-controlled vocabularies such as the *Getty Art* and *Architecture Thesaurus*, *Wikidata.org* and the British Museum Thesaurus. Furthermore, *Nomisma* allows the alignment between partner projects that provide numismatic data to the web and larger digital endeavours such as *Pelagios*. The Simple Knowledge Organisation System (SKOS) allows the mapping between Pleiades URIs for places with the mints collected in *Nomisma* through (`skos:closeMatch`).

Nomisma sits on two important tools, the *Numismatic Description Schema (NUDS)* and the *Nomisma* ontology.[95] *NUDS* is a codified XML schema based on the Numismatic Description Standard, a collection of the most common fields for numismatic databases that proposes a standardised description and a set of representation guidelines. *NUDS* works in conjunction with the *Nomisma* ontology, a domain-specific ontology designed to model numismatic information constituted by 31 classes and 57 properties.

Nomisma provides stable representations of numismatic concepts following LOD standards and relies on a broad community of scholars and institutions. It enables access to a broad range of datasets including that of the American Numismatic Society, the *Coin Hoards of the Roman Republic (CHRR)* and the *Coinage of the Roman Republic Online (CRPO)*. All the datasets are individually licensed and provided through a dump download from the website of *Nomisma*, but they can also be accessed through the website browser and the SPARQL endpoint. *Nomisma* SPARQL endpoint can be considered an example of good practice: it provides example queries that display the potential of the resource, including queries for authorities, e.g., Augustus, average coin weights and spatial queries. The spatial querying in SPARQL can be a very useful resource for archaeological research. In the case of *Nomisma*, the SPARQL endpoint is extended to support spatial interaction with a Solr search index.[96] This allows the dataset to be queried using a GeoSPARQL implementation provided by Jena by following the format of `spatial:nearby`.[97] An example of this can be seen in the following test query 1 for all mints within 200 km of Seville, whose results are provided in appendix 2 as 'Test

95 http://nomisma.org/nuds (accessed June 2020).

96 For further documentation see: http://jena.apache.org/documentation/query/spatial-query.html (accessed January 2018).

97 https://jena.apache.org/documentation/query/spatial-query.html (accessed June 2020).

query 1.' The query requests all mints within 200 kilometers around Seville and applies a filter for English language.

Test query 1 in Nomisma: Obtain all the mints in Ulterior-Baetica. Provided by requesting all the mints within 200 km from Seville.

```
# Definition of the prefixes
PREFIX rdf:    <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX dcterms:    <http://purl.org/dc/terms/>
PREFIX geo:    <http://www.w3.org/2003/01/geo/wgs84_pos#>
PREFIX nm:    <http://nomisma.org/id/>
PREFIX nmo:    <http://nomisma.org/ontology#>
PREFIX skos:    <http://www.w3.org/2004/02/skos/core#>
PREFIX spatial: <http://jena.apache.org/spatial#>
PREFIX xsd:    <http://www.w3.org/2001/XMLSchema#>

# Select clause including the variables required
SELECT ?label ?mint ?latitude ?longitude

# Where clause to define the graph pattern that the data needs to
match to be retrieved. The graph defines the location within the
coordinates established and requests latitude and longitude. A
second pattern, requests mints within the location defined and the
mint of the label.
WHERE {
  ?location spatial:nearby (37.3881 -5.9823 200 'km') ;
    geo:lat ?latitude ;
    geo:long ?longitude .
  ?mint geo:location ?location ;
     skos:prefLabel ?label ;
     a nmo:Mint
# Filter to retrieve the labels of the mints in English since Nomisma
provides several languages.
 FILTER langMatches (lang(?label), 'en')
}
```

As can be seen in the results provided in Appendix 2 – Test Query 1, the query retrieves a list of mints located in a ratio of 200 km around Seville. This application can be quite useful to identify mints in selected areas. The query was run to identify mints within the province of Ulterior Baetica, an objective which is clearly achieved in the list of results. Nevertheless, the results also provided a series of mints located in the north area of Africa such as ‘Tingis’ or ‘Madinat Sabta’, which are not relevant for the case study and therefore should be filtered out by the user. Another issue is presented by the names attributed to some of the mints which do not necessarily match the literature,[98] and furthermore, as this is a spatial query, it does not provide those mints whose specific location has not yet been confirmed, as for example Detumo-Sisipo whose uncertainty is depicted in Fig. 3.8. by the question mark next to the mint’s name. Nomisma does not provide images or bibliographic references associated to the Spanish mints, making it difficult to identify possible errors in the data. All these questions should be taken into account at the time of querying to assess the completeness and validity of the data ingested and its capacity to provide research results. From the test query and the examples given, it is highly recommended to have a close look at the results provided by LOD in these cases. It is important to make sure they are relevant for the research question and support the checking with relevant literature to avoid typographical errors and possible confusion in the identification of certain mints.

Closely related to *Nomisma*’s approach is the *Pelagios Network* (formerly *Pelagios Project*), a community-driven infrastructure for Linked Open Geodata in the Humanities that enables links between digital objects through their common reference to particular places. *Pelagios* allows users with different levels of expertise to access to interconnected online materials through *Digital Maps*, the Peripleo search interface and the API. Maps are provided by *Pelagios* to be incorporated into different digital mapping applications to provide a contextual backdrop for historical data. Peripleo is a browsing engine for data contained in the *Pelagios* network that offers a user-friendly search interface to visualise

[98] See for example ‘Cunbaria’ in Nomisma (http://nomisma.org/id/cunbaria) is identified as ‘Cun(v)baria’ in Garcia y Bellido/Cruces Blázquez (2001b, 110).

annotations embedded in the datasets, enabling users to explore the data and the connections between the different objects and datasets (Fig. 5.9).

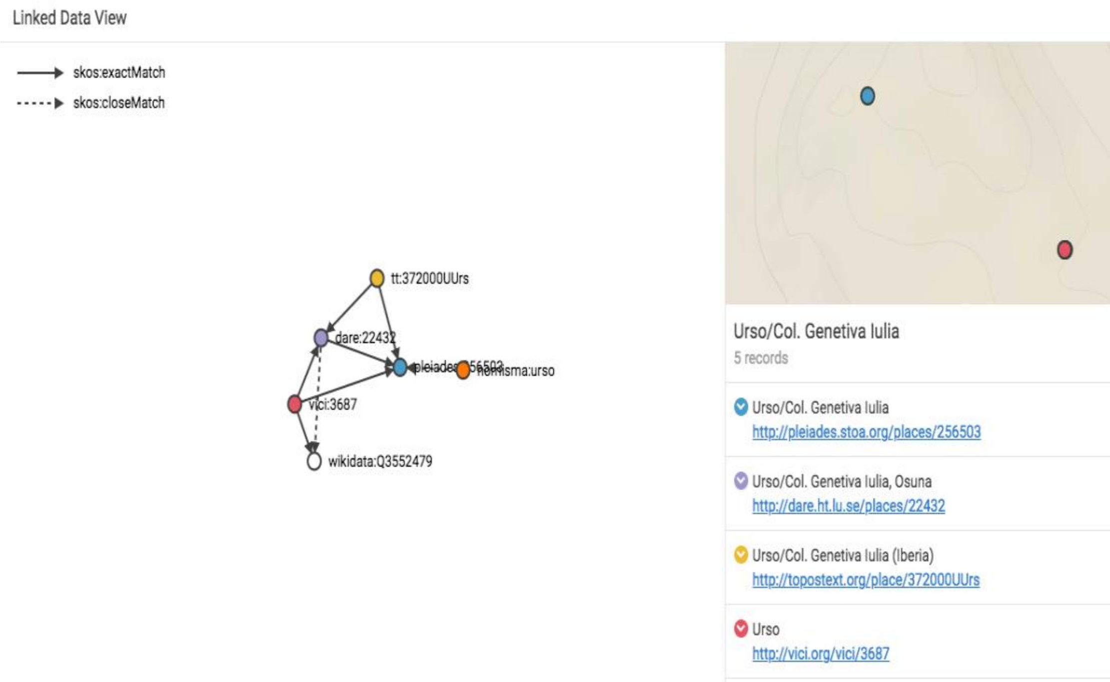

Fig. 5.9. Connections in Peripleo between datasets related to the place of Urso, current Osuna, with a graph for the skos:exactMatch and skos:closeMatch (accesed June 2019) (http://peripleo.pelagios.org/ui#selected=http://pleiades.stoa.org/places/256503).

The *Peripleo* Web API provides machine access to data under a conceptual model that consists only of three types of entities: items, places and datasets. The API returns compact, unformatted JSON responses, generally paginated, that can be converted into human-readable responses by a `prettyprint=true` parameter. The search feature allows querying by keyword, place, space, time interval, dataset or object type. An interesting feature is the possibility to restrict a query to a geographical area when specifying a centre (lat, lon) and radius (in km).

In regard to the case study, Pelagios offers a network of linked data related to settlements in Ulterior Baetica using Pleiades, DARE and the bibliography. The importance of Pelagios in this specific case is the potential of discoverability of relevant resources for the case study, as seen in Fig. 5. 9. The project offers a platform to identify possible connections among the places and the datasets that provide relevant information about them. Other tools provided by Pelagios such as Peripleo and Recogito have already been discussed in Chapter 4, section 4.

5.3.2. Spanish resources

Resource	*Type*	*URL*	*Available in Open Access*	*Machine readable structured data*	*Non-proprietary format*	*W3C Recommendations*	*Links to similar resources*
CVB	**GAZETTEERS**	http://cvb.vrbanitas.es/	★			★	★
Hesperia		http://hesperia.ucm.es/	★				
Base de Datos del Patrimonio Inmueble de Andalucía	**DATABASES**	http://www.iaph.es/patrimonio-inmueble-andalucia/frmSimpleArqueo.do	★	★	★	★	★
Hispania Epigraphica		http://eda-bea.es/	★				
Domus	**CATALOGUES**	http://www.juntadeandalucia.es/cultura/WEBDomus	★				
CERES		http://ceres.mcu.es/pages/SimpleSearch?index=true	★				

Table. 5.2. Classification of Spanish resources. Green shows total compliance with Berners-Lee five-stars criterion, orange partial compliance, and red the least. Empty boxes show zero compliance.

5.3.2.1. Gazetteers

The *Corpus Urbanorum Baeticarum* (CVB) (Table 5.2) was published in 2018 and it aims to make available a comprehensive corpus of information for all the cities in Roman Baetica. It advertises itself as compiling the most up-to-date archaeological information on the settlements including architecture, necropolis, sculpture, epigraphy, coinage, and state of conservation. The resource divides the province into its four Roman *conventus* of which only two have been uploaded so far: Hispalensis and Astigitanus.[99] For each *conventus*, all the cities existing during the period of Roman Baetica have been listed, identified historically and geographically where possible, and displayed together with additional information regarding the fields mentioned as seen in Fig. 5.10.

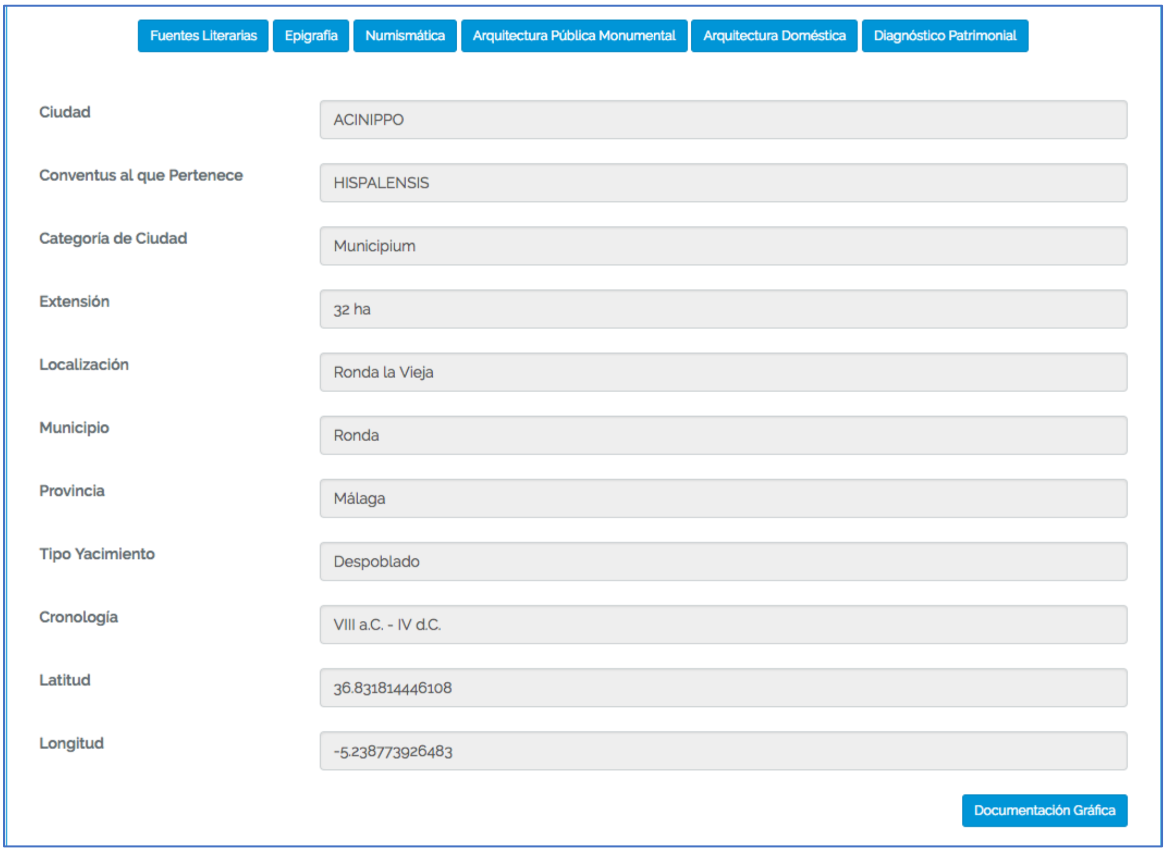

Fig.5.10. Acinippo in CVB (cvb:95) (accessed June 2020).

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[99] '*Conventus iuridicus*' is a Roman juridical demarcation generated in the Augustan period that divided certain provinces of Dalmatia, Asia and Hispania into smaller territories. The name derives from the Latin word *conventus,* meaning the meeting of several members of both Roman and indigenous communities to solve administrative matters (Santos Yanguas 2017).

CVB has proved to be a very useful resource for the study of early Roman Spain. It provides a comprehensive description of the cities in Roman Baetica together with detailed information for each specific centre supported by bibliographic references and further literature. In terms of completeness and accuracy of the data, CVB is one of the best examples. Nevertheless, the resource still shows several limitations regarding data accessibility and interoperability. *CVB* can be accessed through a browser, a map and a list. Once a town is selected from each of the search fields, the information about the town is displayed in HTML. Despite the fact that the corpus is open access, all the data provided is under copyright so it cannot be re-used without consent. Furthermore, the data cannot be exported in any format, and despite the fact that *CVB* refers to other resources for each of the cities, it does not employ hyperlinks so the user cannot easily navigate between sites, significantly diminishing the potential of the reference.

Although the resource identifies itself as a corpus, I have decided to consider it a gazetteer because of its orientation towards the collection of information about the cities in Baetica which are considered the skeleton of the resource, and the rest of data is complementary to them. CVB provides a significant amount of relevant information for the case study, verified by experts in each of the fields and in most of the cases with a higher level of completeness to that encountered in other gazetteers such as Pleiades or DARE, nevertheless, difficulties to access the data displayed for each of the sites impedes for the resource to be considered a database.

5.3.2.2. Databases

Hesperia is a database that makes available the whole corpus of Paleohispanic inscriptions from the Iberian Peninsula. It was conceived as a collaborative effort of several Spanish universities and constitutes a necessary resource for the study of the pre-Roman era in Hispania. It provides a significant corpus of Paleohispanic inscriptions supported by bibliographic references, translations and editorial comments.

Despite its importance as a documentary source of the languages spoken in the peninsula before Roman conquest, *Hesperia* presents significant limitations regarding data access, interoperability and sharing. The records can only be accessed through the interface browser and downloaded in PDF format. Only the images are under a Creative Commons License, with no more information provided about the licensing of the texts. In terms of accessibility, Hesperia does not provide disambiguated URIs, which impedes the citing of permanent links to the records and it prevents other repositories from linking to them (Granados 2017).

Hesperia and CVB constitute an example of how institutional databases can become data silos that hinder access to public data, making it impossible for a third party to query or computationally process the information. Despite the significant accuracy and completeness of the data provided, the findability of the content is restricted to browser facilities on the respective Web portals and even then, the functionality offered is far from meeting consumer needs in terms of data sharing and accessibility.

A very different case is the Instituto Andaluz de Patrimonio Histórico (IAPH). *Guia digital.iaph* is a web application that allows the querying of the data management system of the cultural heritage of Andalucía, which consists of more than 24,000 entities of archaeological, architectonic and ethnological heritage. The IAPH database for the Patrimonio de Andalucía compiles records for Roman and pre-Roman settlements in the province of Andalucía collected within the *Catálogo General de Patrimonio Histórico*. It also records successive excavations, chronology of the site and related bibliography. Although the resource lacks a SPARQL repository, IAPH can be queried for specific places with the embedded search. Every query provides a URI that resolves to the archaeological records of the place in HTML. IAPH´s URIs (see for example https://guiadigital.iaph.es/bien/inmueble/7628) are stable and provide a single identifier for each record following W3C recommendations. The resource also provides machine-readable data exports for each record in JSON-LD, a format to which RDF can be fully mapped. The following table shows a data snippet for the record of Olontigi in IAPH downloaded from the stable URI for the Ibero-Roman town of Olontigi (Aznalcázar, Sevilla).[100]

JSON-LD data for Olontigi in IAPH:

{
  "codigos_iaph": 410120006,
  "tipologiaList": {
    "tipologia": [
      {
        "crono_fin": null,
        "den_tipologia": {
          "@id": "iaph:e-Asentamientos",
          "rdfs:label": "Asentamientos",
          "prov:wasAssociatedWith": [
            {
              "@id":
"http://es.dbpedia.org/resource/Asentamiento"

[100] https://guiadigital.iaph.es/bien/inmueble/7628 (accessed August 2020).

```
            },
            {
              "@id": ""
            }
          ],
          "@type": "iaph:Objetos_inmuebles"
        },
        "den_etnia": null,
        "denom_acti": null,
        "crono_ini": null,
        "periodos_cod": "9.2659.2691",
        "crono_ini_cod": null,
        "den_etnia_cod": null,
        "crono_fin_cod": null,
        "periodos": {
          "@id": "iaph:e-Edad_Media",
          "rdfs:label": "Edad Media",
          "prov:wasAssociatedWith": [
            {
              "@id":
"http://es.dbpedia.org/resource/Edad_Media"
            },
            {
              "@id": ""
            }
          ],
          "@type": "iaph:Periodos_historicos"
        },
        "denom_acti_cod": null,
        "den_estilo_cod": null,
        "den_estilo": null,
        "den_tipologia_cod": "7.492.495.567"
      },
      {
        "crono_fin": null,
        "den_tipologia": {
          "@id": "iaph:e-Murallas",
          "rdfs:label": "Murallas",
          "prov:wasAssociatedWith": [
            {
              "@id": "http://es.dbpedia.org/resource/Muralla"
            },
            {
              "@id": "http://datos.bne.es/resource/XX525622"
            }
          ],
          "@type": "iaph:Objetos_inmuebles"
        },
        "den_etnia": null,
```

```
        "denom_acti": null,
        "crono_ini": null,
        "periodos_cod": "9.2659.2691",
        "crono_ini_cod": null,
        "den_etnia_cod": null,
        "crono_fin_cod": null,
        "periodos": {
          "@id": "iaph:e-Edad_Media",
          "rdfs:label": "Edad Media",
          "prov:wasAssociatedWith": [
            {
              "@id":
"http://es.dbpedia.org/resource/Edad_Media"
            },
            {
              "@id": ""
            }
          ],
          "@type": "iaph:Periodos_historicos"
        },
        "denom_acti_cod": null,
        "den_estilo_cod": null,
        "den_estilo": null,
        "den_tipologia_cod": "7.492.494.497.508.515.958"
      },
      {
        "crono_fin": null,
        "den_tipologia": {
          "@id": "iaph:e-Asentamientos",
          "rdfs:label": "Asentamientos",
          "prov:wasAssociatedWith": [
            {
              "@id":
"http://es.dbpedia.org/resource/Asentamiento"
            },
            {
              "@id": ""
            }
          ],
          "@type": "iaph:Objetos_inmuebles"
        },
        "den_etnia": {
          "@id": "iaph:e-Iberos",
          "rdfs:label": "Iberos",
          "prov:wasAssociatedWith": [
            {
              "@id": "http://es.dbpedia.org/resource/Iberos"
            },
            {
```

```
              "@id": "http://datos.bne.es/resource/XX4576478"
            }
          ],
          "@type": "iaph:Etnias"
        },
        "denom_acti": null,
        "crono_ini": null,
        "periodos_cod": "9.2659.9982.10406.2689.2704",
        "crono_ini_cod": null,
        "den_etnia_cod": "2.4701.4931",
        "crono_fin_cod": null,
        "periodos": {
          "@id": "iaph:e-Edad_del_Hierro_II",
          "rdfs:label": "Edad del Hierro II",
          "prov:wasAssociatedWith": [
            {
              "@id":
"http://es.dbpedia.org/resource/Cultura_de_La_Tène"
            },
            {
              "@id": ""
```


As shown in the snippet from IAPH[101], certain properties from the RDFS schema have been used in the data modelling such as (`"rdfs:label"`) this improves the compliance of the resource with the W3C recommendations and allows better data consistency with the LOD cloud. The snippet also shows that the data provided contains links to the National Library of Spain and to DBpedia (see for example the data provenance snippet: `"prov:wasAssociatedWith":[{"@id":"http://es.dbpedia.org/resource/Muralla"},{"@id":"http://datos.bne.es/resource/XX525622"}).` In the example, the resource is linking the wall of the site to the URI for the resource in DBpedia and the repository of the Biblioteca Nacional de España. The IAPH data also provides links to Wikidata although this is not shown snippet.

Following the W3C recommendations, data providers can link their data to other sources and repositories, bringing context to their information. In this case, IAPH is linking its

[101] Note that labels are coloured in black while data values are coloured in green to improve readability.

data to significant data repositories in the LOD cloud such as DBpedia and Wikidata. The interlinkage with other resources is the prerequisite to get the fifth star for Linked Open Data according to Berners-Lee five-star criteria. In this way, users can discover more interlinked information when using the repository. In contrast to Hesperia or CVB, IAPH shows an exceptional compliance with W3C recommendations providing therefore better access to institutionally curated information and facilitating its sharing and interoperability.

5.3.2.3 Catalogues

The *Red Digital de Colecciones de Museos de España (CERES)* and the *Portal de Museos y Conjuntos (Domus)* are two web applications that provide access to museum catalogues in Spain. *Domus* and *CERES* allow the user to run queries across all Spanish museum databases, so they are a fundamental resource for archaeological research. Nevertheless, the museum catalogues to which they provide access follow a similar philosophy to that of *Hesperia* and *CVB*. Once a query keyword is given, the system provides a list of potential matches, the museums where the objects are collected and the URL of the collection database record. When the user clicks on the specific object, the catalogue information is displayed on screen in traditional HTML. Data management systems tend to be outdated, the records can only be exported in PDF format, and there is no compliance with any of the LOD recommendations, making it hard for the scholar to access the data, and to share and reuse the information obtained.

In the two years since 2010, a Semantic Web of archaeological data has progressively grown to encompass vocabularies, information and recommendations regarding archaeology, cultural heritage and similar fields of research. Despite skepticism, the LOD approach has already shown its benefits in the ancient world community (Elliot/Heath 2014 in ISAW papers 7). LOD technologies could improve Spanish data access, interoperability and discoverability but also the sustainability, processing, querying and accessibility of the data allowing the researcher to connect information from unrelated sources, thereby providing the data with some context, a fundamental interrogation in archaeological scholarship.

5.4. Analysis and conclusions

The archaeological or archaeology-related resources analysed in this survey have been divided into two large groups according to the origin of the team and the funding received (international and Spanish) and then into different categories depending on the type of data collected and the applications provided.

Within the group of international resources, the panorama is optimistic. From the eight resources surveyed, six of them are rated with five stars within the Berners-Lee criteria.[102] The two remaining resources are rated four stars showing, therefore, a very good average overall. If we draw a deeper analysis of the results, we can see that of the three categories of resources, gazetteers and collaborative projects are more inclined towards the application of LOD standards. Databases seem to be more reluctant to incorporate this change. This sort of resource tends to use URIs to identify entities and provide catalogue information about the objects collected; however, in most cases, the data is not

[102] It should be taken into account that these resources have been selected for a specific case study, therefore whereas the conclusions cannot be representative of all international resources, they can be significant for this specific research question and therefore meaningful for the understanding of the availability and accessibility of LOD for archaeological investigation related to the Iberian Peninsula.

downloadable or in an open access format. This situation might relate to problems of compatibility with existing standards, potential costs of converting legacy data and legal impediments to giving open access to this sort of information.

Nevertheless, the situation is different for Spanish resources. In this case there are no cooperative resources that can be considered ‘collaborative’ on the same level as *Nomisma* and *Pelagios*, so the categories selected are databases, gazetteers and catalogues. In terms of LOD standards, leaving aside the exception of IAPH which shows a total compliance with LOD, the rest of resources seem to be far from implementing Linked Data technologies. Within the category of gazetteers only two of the six resources surveyed achieved three stars. Spanish resources seem to provide better quality data in terms of curatorial effort. In most of the cases the resources are supported by bibliographical references, editorial comments and complementary literature (see for example CVB and Hesperia). Nevertheless, whereas the data seems to be both more complete and accurate, its value to the computational researcher is hindered by the several barriers to the access and consumption of the information. The Spanish archaeological resources surveyed allow little access to their contents and impede data querying and processing.

With the exception of IAPH that provides link to major partners of the LOD cloud, the lack of interlinkage with other resources hinders their discoverability online and the findability of content is restricted to browsing facilities on the respective Web portals making the functionality offered by these resources far from ideal (Granados 2017). It could be argued here that the main concern of the researchers that use these resources is the quality of the data and not necessarily its accessibility through APIs or LOD technologies. While this statement may be true, with the advancement of Digital Humanities, every day more researchers are increasing their knowledge and skills in terms of data management and data access and this has but augmented the demand for information to be freely available on the web in a form that guarantees its consumption and accessibility. There is a new kind of researcher for whom databases like Hesperia or CVB will be excluded because of a lack of accessibility of the resources and impediments in the processability of the data. One of the ways to avoid this is the understanding that the completeness and accuracy of the information are not of much use if the data cannot be accessed and reused. In this regard, the following chapter focuses further on the potential challenges and provides potential solutions to approach them in terms of data incompleteness, interoperability and accessibility.

Chapter 6: Data Collection and Integration

Overview

Chapter 5 consisted of an identification and survey of the different resources available online that this research explores and consumes for the study of cultural contact in early Roman Ulterior-Baetica. Chapter 6 focuses on the methodological guidelines followed for the collection and integration of data into an RDF dataset that I have generated ad hoc for the purposes of this research, namely the ERUB (Early Roman Ulterior-Baetica) dataset. The ERUB dataset consists of LOD data consumed online from the already surveyed resources and data collected and integrated manually from relevant scholarship through the process described in this chapter and the following.

6.1. Available data consumption

The World Wide Web Consortium contemplates the generation of a 'Web of Data', an information space in which data can be queried and accessed online. This allows the user to query several repositories at once through a single SPARQL endpoint using the so called 'federated queries' which can request data from several services at the same time. On this matter, the work developed at the OpenArchaeo project is especially significant (Marlet et al. 2019).[103] The endeavour aims to make the large set of archaeological data from the Laboratorie d'Archaeologie et Territoires (CITRES-LAT) openly available and interoperable through the principles of LOD. For this purpose, the CIDOC-CRM ontology was selected to map the different datasets which are available for querying at OpenArchaeo, a semantic mediator that interlinks the datasets with common generic

103 http://openarchaeo.huma-num.fr/federation/?lang=en# (accessed September 2020).

models used on archaeological excavation data. The service provides the 'OpenArchaeo Federation', a foundation layer that allows the execution of federated SPARQL queries through a federated query library. The data provided by this service comes mainly from French archaeological datasets, so it is out of the scope of ERUB. Nevertheless, this example constitutes a significant development in semantic interoperability for archaeological research.

Nevertheless, federated queries can also be problematic and not all query services take advantage of them. To facilitate offline research, I have generated the ERUB (Early Roman Ulterior Baetica) dataset. ERUB is an RDF dataset that gathers both the data collected online —therefore boosting the consumption of LOD —and new data generated ad hoc within the scope of cultural interaction, also building an understanding of the LOD production process. ERUB consists of data collected in three different ways: a) consumed directly from the web as LOD, b) consumed as raw data from web-exposed databases and then integrated as LOD and, c) consumed manually from relevant scholarship and integrated as LOD.[104]

It is important to understand here that ERUB is constituted by two different types of information, on one side there is the so-called 'tombstone data': this is the basic standard information about the records collected in ERUB e.g., measures, provenance, dates, period etc. and the 'cultural contact data'. The tombstone data has been ingested from the web when possible and integrated as LOD from scholarship when necessary. In those cases, in which the data has been integrated from the web as LOD (i.e., Nomisma, Pleiades and EDH) the data model has been maintained with the properties chosen by the information source. In the same way, in those cases where the information has been newly

[104] The main datasets that integrate ERUB are sumarised in Appendix 2.

generated, the data has been integrated using the already existing ontologies when possible,[105] that is, the ontologies used to model the resources ingested in the database e.g., Pleiades vocabularies, the Nomisma ontology and the EDH ontology. This has made the alignment easier between the different datasets and the modelling process less complex since there was a previous understanding and familiarity with the data coming from these resources surveyed in chapter 5. On the other side, the 'cultural contact data' has been modelled using CuCoO, the cultural contact ontology applied to the data already collected in ERUB.

Since cultural contact information is expected to be derived from background data, I have decided to explain first the modelling of the tombstone data to then focus on the design and development of CuCoO and the data generated by the inference rules applied to CuCoO in chapter 7. In this way, the ordering of the chapters follows the natural reasoning of cultural contact detection.

The scholarship and archaeological campaigns carried out in southern Spain in the last decades have brought to light a full range of evidence that can be considered in discussions about cultural contact; including epigraphy, coinage, sculpture and settlements' data but also pottery, urbanism, or prosopography among others. In contrast to the full range of evidence that could be considered in this research, I have taken into account the data that is available online either as LOD, or as web-exposed data that can be consumed and integrated as LOD. In this regard, this research has evaluated the information currently available to select four indices that: a) could provide enough volume of data to be queried with reference to the research questions, b) could be

[105] This is when the required properties where available. In those cases where the properties did not exist, they had to be generated in CuCoO.

integrated and related together by common references to places, communities, language or writing systems and c) could be easily collected online or integrated from scratch with Python scripts. This process has led to the selection of four indices discussed in depth in Chapters 2, 3 and 5 which are: 1) settlement (geographical data), 2) epigraphy (inscriptions), 3) coinage (coin legends/inscriptions and mints) and 4) sculpture (iconography and style). The fact that a large amount of information that could be explored in this research is not still available speaks about the limitations of this approach in terms of lack of access to the full range of evidence. It is not ideal to explore a research question with only a percentage of the evidence available, and this will have implications in the assessment of the results obtained. However, the lack of evidence also underlines the necessity of studies like this that can assess the amount of data currently available online and the possibilities offered by LOD to the consumption and interlinking of this information. Regarding the four indices selected, the resources surveyed in Chapter 5 provide relevant LOD for three of them: epigraphy, settlements and coinage (mints).

6.1.1. Epigraphy

The digital representation of epigraphs has become a major research interest in recent decades. Epigraphs are texts recorded in hard surfaces such as metal, stone or pottery that can vary in length and were mainly intended to remain across time (Luis-Álvarez/García-Barriocanal/Gómez Pantoja 2010, 222). Digital epigraphy projects have traditionally focused on the development of epigraphic databases that ensure the preservation and dissemination of ancient texts. Today, these efforts are embodied in the development of a number of operative databases that allow management and querying of data. The epigraphic record of early Roman Spain is one of the best systematised and documented collections. Spanish epigraphic databases such as *Hispania Epigraphica* have been partially incorporated into international projects that comply with LOD standards and provide wider access to the data, e.g., the *Epigraphic Database of Heidelberg*. *EDH* provides a large subset of early Roman Latin inscriptions coming from the peninsula. This data can be directly downloaded as a data dump from the *EDH* website and then queried locally for more relevant or specific subsets of data. It is important to emphasise here that EDH only collects Latin inscriptions from Spain, therefore the data collected from EDH will only provide epigraphic inscriptions written in Latin and no other Paleohispanic languages. *EDH* data has been ingested as RDF and integrated into the ERUB dataset. A sample can be seen in the following Turtle snippet:

RDF SAMPLE 6.1. EDH

```
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .
@prefix nmo: <http://nomisma.org/ontology#> .
@prefix epi: <http://edh-www.adw.uni-
heidelberg.de/edh/ontology#> .
@prefix dc: <http://purl.org/dc/terms/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix lawd: <http://lawd.info/ontology/> .

<http://edh-www.adw.uni-heidelberg.de/edh/inschrift/HD030584>
       a epi:inscription ;
       skos:prefLabel ‘epitaph found at 'Iliberri Florentia?
Granada?;'; from Roman province Baetica’@en ;
       dc:publisher <http://edh-www.adw.uni-heidelberg.de> ;
       dc:contributor <http://edh-www.adw.uni-
heidelberg.de/edh/contributor/graef> ;
       dcterms:date ‘2000-01-28’^^xsd:date ;
       epi:representsTypeOfMonument <http://edh-www.adw.uni-
heidelberg.de/edh/type_of_monument/urn> ;
```

```
        epi:representsTypeOfInscription <http://edh-www.adw.uni-heidelberg.de3/edh/type_of_inscription/epitaph> ;
        lawd:foundAt <http://edh-www.adw.uni-heidelberg.de/edh/geographie/2438> ;
        nmo:hasStartDate '-0100' ;
        nmo:hasEndDate '-0001' ;
        nmo:hasMaxHeight '23' ;
        nmo:hasMaxWidth '37' ;
        nmo:hasMaxDepth '25' ;
        epi:hasWorkstatus <http://edh-www.adw.uni-heidelberg.de/edh/workstatus/completed_checked_with_photo> ;
        epi:hasPerson <http://edh-www.adw.uni-heidelberg.de/edh/people/HD030584/1> ;
        foaf:depiction <http://cil-old.bbaw.de/test06/bilder/datenbank/PH0005423.jpg> ;
        epi:hasEditionText 'Asanan'@lat ;
        epi:hasDiplomaticText 'ASANAN'@lat .
```

The sample displays data on an inscription from Granada (HD007273) with the ID http://edh-www.adw.uni-heidelberg.de/edh/inschrift/HD007273. *EDH* uses ten different ontologies to record the information about the inscriptions recorded in the database. In this case, the main ontologies used include:

- Dublin Core terms for the metadata (e.g., `dc:publisher`, `dc:contributors`).[106]
- The *Nomisma* ontology for dates and measures (e.g., `nmo:hasStartDate`, `nmo:HasEndDate`, `nmo:hasMaxWeight`, `nmo:hasMaxDepth`).
- The *EDH* ontology developed especially for the project and declared with the prefix (epi) used for metadata on the inscription (e.g., `epi:typeOfMonument`, `epi:typeOfInscription`), and the data on the text itself (e.g., `epi:hasEditionText`, `epi:hasDiplomaticText`).

[106] The http://purl.org/dc/terms/ namespace refers to the Dublin Core Metadata Initiative for properties, classes and datatypes (accessed September 2020).

Through the modelling shown above, EDH LOD makes available a subset of the Latin inscriptions collected in other Spanish datasets such as Hispania Epigraphica. The inscriptions are identified by URIs and relevant information is provided including chronological and geographical context, metadata and information about the inscription (i.e., language, support, edition text…). This LOD data has been ingested into a graph as part of the epigraphic data collection of ERUB.

6.1.1.1. Problems with epigraphic data

The RDF provided by EDH delivers metadata on the inscription as well as the inscription's transcript; however, it does not provide epigraphic information as computational semantics.[107] In 2010 Álvarez, Gómez-Pantoja and García-Barriocanal (2010) developed a prototype for an ontology based in Epidoc, the 'EpiOnt' ontology. EpiOnt is an OWL ontology based on the XML Epidoc format that allows the modelling of concepts within the epigraphic domain. This means not just the translation of the format of the data from XML to OWL but the conversion of all the Epidoc entities required for the transcription of text into OWL classes and properties. Similar efforts have been conducted within the CIDOC CRM community that have developed in an extension for the modelling of epigraphic material (CRMepi) (Felicetti et al. 2015). As of March 2020, the discussion is still ongoing, and a set of meetings and workshops have taken place, the last being in Oxford 2018, that pursued the possibility of integrating epigraphic data as LOD.[108]

[107] Within the growing interest in the digitising and conserving ancient text, initiatives such as Epidoc have emerged. The Epidoc specification (Bodard 2010) recommends the use of XML (Extensible Markup Language) for the encoding of epigraphic information.
[108] http://epigraphy.info/ (forthcoming).

Returning to the *EDH* inscription, we can see from the level attached to the transcription that the text is written in Latin (epi:hasEditionText 'Asanan'@lat). To record the language of the inscriptions, EDH uses plain literals associated with a language tag (e.g., 'Asanan'@Lat). This is a quick and pragmatic solution for EDH because it is a dataset that only collects inscriptions written in Latin. However, this solution can be less useful in bigger datasets that collect inscriptions written in different languages or whose origins are in a different language from the script used. To allow more flexibility in the modelling of the languages and scripts used in the coins' legends and the inscriptions recorded in other media e.g., sculptures, ERUB uses properties from CIDOC-CRM and the ResearchSpace ontology such as (crm:P72_has_language) and (rs:PX_inscription_script). These allow more flexibility in the modelling and the querying as will be explained in the following sections.

EDH also provides information about the onomastics recorded in the inscription using (epi:hasPerson). This property links the inscription to the potential person name mentioned in the text including further information. These sorts of statements allow the querying of inscription dates, provenance and personal names. However, there are not further statements about the linguistic features of the text itself, nor the possible cultural connections between the text and the communities that created it. EpiOnt, mentioned above, suggests several classes and properties to record this sort of data in RDF. Some examples of this are (epiont:has_Person), epiont:has_Editor) and (epiont:hasCivilization). The property (epiont:hasCivilization) formally represents the link between the inscription (domain) and the civilisation (range) (Álvarez/García-Barriocanal/Gómez-Pantoja 2010, 226). This sort of modelling could provide a way of retrieving inscriptions through cultural assumptions.[109] A similar process to this is carried out in CuCoO using the property (`cucoo:isAssociatedWith`) to connect the domain (`cucoo:CulturalAgent`) to the range (`cucoo:CulturalIdentity`). Nevertheless, as explained above, there is still no definite ontology for epigraphic modelling and properties such as these are still not recorded in epigraphic data.

As can be seen in the data sample above (6.1), EDH uses properties from the Nomisma ontology to model the chronology of the inscriptions and their measures. The fact that a non-numismatic project is using the Nomisma ontology is interesting and speaks of the pragmatism of the ontology. It also makes ERUB more internally consistent since it integrates epigraphic and numismatic data. Nevertheless, it is not best practice to use a numismatic ontology to model epigraphic data especially when the definitions of the ontology make reference to numismatic objects e.g., EDH uses (`nmo:hasStartDate`) which is defined in Nomisma.org as 'Identifies the initial date in a range assigned in a numismatic context'.[110] Whereas the solution fulfills its objective, there should be a balance between pragmatism and semantic purity. This solution is not perfect and alternatives for more long-lasting projects should be suggested. Another possibility is suggested in CuCoO by the minting of a new property (`cucoo:StartDate`) that has the same functionalities of the Nomisma property but is not necessarily constrained to numismatic objects as will be explained in section 6.4 (Graph 1 Settlements).

[109] The linkage between objects and communities based upon cultural assumptions is further discussed in Chapter 7.
[110] For the definition see http://nomisma.org/ontology#hasStartDate (accessed August 2020).

6.1.2. Settlements

Regarding settlement data, *Pleiades* registers approximately 210 pre-Roman and Roman towns identified in the area of Ulterior-Baetica. The data provided for these settlements has been checked individually and downloaded as RDF. As can be seen in the RDF sample 5.1., the prefixes are declared in the first place followed by the metadata and the data about the settlement, in this case Gades.

RDF SAMPLE 6.2. PLEIADES

```
@prefix cito: <http://purl.org/spar/cito/> .
@prefix dcterms: <http://purl.org/dc/terms/> .
@prefix foaf: <http://xmlns.com/foaf/0.1/> .
@prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
@prefix osgeo:
<http://data.ordnancesurvey.co.uk/ontology/geometry/> .
@prefix owl: <http://www.w3.org/2002/07/owl#> .
@prefix pleiades: <https://pleiades.stoa.org/places/vocab#> .
@prefix prov: <http://www.w3.org/TR/prov-o/#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .
@prefix spatial: <http://geovocab.org/spatial#> .

<https://pleiades.stoa.org/places/256177#this> a
<http://geovocab.org/spatial#Feature>;
  rdfs:label ‘Gadeira/Gades/Col. Augusta Gaditana’;
  spatial:C <https://pleiades.stoa.org/places/434822371#this>,
    <https://pleiades.stoa.org/places/663803333#this>,
    <https://pleiades.stoa.org/places/803793619#this>;
  rdfs:comment ‘Gadeira/Gades/Col. Augusta Gaditana (modern
Cádiz, Spain) is an ancient city of Spain and one of the
oldest continuously occupied cities of Europe. Its origins may
be Phoenician (Gadir (Phoenician: גדר)).’;
  foaf:primaryTopicOf
<https://pleiades.stoa.org/places/256177> .

<https://pleiades.stoa.org/places/256177> a
<http://www.w3.org/2004/02/skos/core#Concept>,
    <https://pleiades.stoa.org/places/vocab#Place>;
  dcterms:bibliographicCitation
    ‘Die Völker und die Städte des antiken Hispanien 37-48’,
    ‘TIR Emerita 82-84’,
    ‘ToposText Gadeira (Spain)’,
```

```
    'Wikipedia (English) Cádiz';
  dcterms:contributor <http://darmc.harvard.edu>,
    <http://viaf.org/viaf/59162760>,
    <https://pleiades.stoa.org/author/bkiesling>,
    <https://pleiades.stoa.org/author/jahlfeldt>,
    <https://pleiades.stoa.org/author/jbecker>,
    <https://pleiades.stoa.org/author/mimno>,
    <https://pleiades.stoa.org/author/sgillies>,
    <https://pleiades.stoa.org/author/thomase>,
    <https://pleiades.stoa.org/author/warner-r>;
  dcterms:coverage 'Cádiz';
  dcterms:creator [ a <http://xmlns.com/foaf/0.1/Person>;
      foaf:name 'Jr.' ],
    <http://viaf.org/viaf/13810037>,
    <http://viaf.org/viaf/84714015>;
  dcterms:description 'Gadeira/Gades/Col. Augusta Gaditana
(modern Cádiz, Spain) is an ancient city of Spain and one of
the oldest continuously occupied cities of Europe. Its origins
may be Phoenician (Gadir (Phoenician: גדר)).';
  dcterms:modified '2019-06-13T12:55:04-04:00';
  dcterms:subject 'dare:ancient=1',
    'dare:feature=major settlement',
    'dare:major=1';
  dcterms:title 'Gadeira/Gades/Col. Augusta Gaditana';
  cito:citesAsEvidence
<http://data.perseus.org/citations/urn:cts:greekLit:tlg0099.tl
g001.perseus-grc1:3.5.5>,
    <http://latin.packhum.org/loc/978/1/316/500-508>,
<http://www.perseus.tufts.edu/hopper/text?doc=Hdt.%204.8&lang=
original>;
  cito:citesAsRelated
<http://www.trismegistos.org/place/13580>;
  cito:citesForInformation
<http://atlantides.org/bibliography/>,
    <http://latin.packhum.org/loc/929/1/2/1470-1473,15837-
15840,27475-27478,30751-30754,33272-33275#2>,
    <http://openlibrary.org/works/OL8327792W>,
<http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3
A1999.04.0064%3Aalphabetic+letter%3DG%3Aentry+group%3D1%3Aentr
y%3Dgades-geo>,
<http://www.perseus.tufts.edu/hopper/text?doc=Perseus:text:199
9.04.0006:entry=gadir>,
    <http://www.worldcat.org/oclc/36156421>,
    <https://en.wikipedia.org/wiki/Cádiz>,
    <https://topostext.org/place/365-063PGad>,
    <https://www.zotero.org/groups/pleiades/items/K9DTWREG>;
  rdfs:seeAlso <https://pleiades.stoa.org/places/434822371>,
    <https://pleiades.stoa.org/places/663803333>,
    <https://pleiades.stoa.org/places/803793619>;
```

```
  owl:sameAs <http://pleiades.stoa.org/places/256177>;
  geo:lat 36.529723;
  geo:long -6.29246;
  skos:altLabel ‘Cadiz’@en,
    ‘Urbs Iulia Gaditana’@la,
    ‘Γάδειρα’@grc,
    ‘Col. Augusta Gaditana’,
    ‘Gades’;
```

Pleiades data includes valuable information about the place, its different names over time and, more importantly, its geographical coordinates (latitude/longitude). Therefore, by ingesting *Pleiades* data into the triple store, we can query the geographical coordinates of each of the settlements and represent them on a map. Nevertheless, *Pleiades* data does not include other features about the places which are relevant for this research.

6.1.2.1 Problems with settlements data

In the case of Ulterior-Baetica, many places receive a different name after Roman conquest and most of them change their legal status over time going in most of the cases from *oppidum* to stipendiary city, *municipium* and *colonia*. *Pleiades* collects information about name changes including timespans of each name. Nevertheless, in most cases, the legal status changes are not specified in the data and the time periods associated with the name variations correspond to unhelpfully large timespans.[111] One example is the pre-Roman settlement of Urso.[112] Urso appears for the first time in the sources as a winter refuge during the Second Punic War in 212 BCE (Appian, *Iberica* 16). After the battle of Munda, the town ended up under the control of Caesar, who established in 44 BCE the

[111] For *Pleiades* classification of time periods see https://pleiades.stoa.org/vocabularies/time-periods (Last accessed August 2020).
[112] For the record of Urso se: https://pleiades.stoa.org/places/256503 (Last accessed August 2020).

Colonia Genetiva Julia. The city received at least 4 different names over time. The Pleiades record for Urso collects three different names each of them with their corresponding URI and timespans (Fig. 6.1).

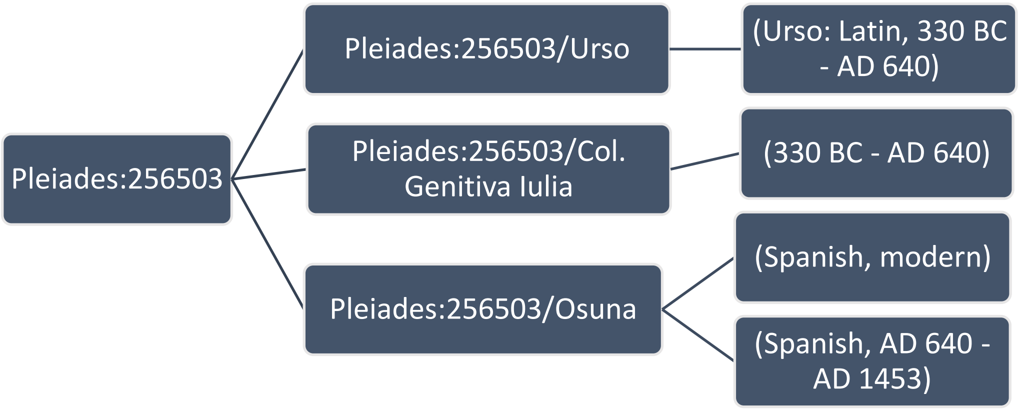

Fig. 6.1. Data model for names and timespans for the record of Urso in Pleiades.

The main URI provides RDF for all this information, in which both the names and timespans are collected. The timespans are not given numerically but as periods (e.g., Roman, late antique or modern). Every name has its own URI (e.g., https://pleiades.stoa.org/places/256503/urso). This URI displays HTML about the record, annotated with RDFa. *Pleiades* does not register the changes in the legal status of the place nor the specific date when the *colonia* was founded, understandable given that it is very unlikely that this information is available for the almost 33,000 names that the gazetteer records. However, information such as this can be quite revealing. Other information of interest for this research that is not recorded in *Pleiades* are the 'ethnic identities' of groups that inhabited the different settlements over time or the history of archaeological excavation in the place. Since the new information is very specific, it was decided to generate completely new triples rather than editing Pleiades data. The new settlement data together with the numismatic and the sculptural data had to be integrated as new data generated ad hoc. The next section explains how this information has been integrated with the RDF provided by *Pleiades*.

Whereas Pleiades has substantial information (e.g., the location of the places, chronological frame of occupation, evolution of the names, references and linked resources) it does, however, lack other important data that is relevant for the research questions (e.g., the change of juridical status, the ethnic groups or the archaeological record). The fact that Pleiades lacks significant information for this research is important to assess the reliability of the resource in this specific context. While the resource has proven to be useful for general uses, it may not be the best source of information to explore specific questions within one single project. This does not speak about the utility of Pleiades but about the way in which the user needs to approach the resource and the extent to which the resource may be able to answer certain questions. There is a certain tendency to expect digital resources to contain all the information available about the collections they host, something that normally never happens. A way to solve this issue could be facilitated by the resources specifying the sort of data that they provide, but most importantly, the information that they lack and the sort of things that the user can or cannot do with them. This would save time and avoid confusion to the user. Another way, which has been the approach taken in this research, requires a careful assessment of the information provided and a workflow put in place to fill in the information gaps when necessary. In other cases, it may be necessary to avoid using certain resources (because of the difficulties they pose) or to take a different approach that perhaps relies more in other non-digital sources of data.

In any case, the fact that some resources may not be complete enough to address the research questions also has certain implications regarding the efficacy of the method. Whereas LOD technologies facilitate the access to the information, the discoverability of new resources and the contextualisation of the data, they can also pose a burden regarding the trustworthiness of the information and the incompleteness of the data for research-specific purposes.[113] What is important to emphasise here is the necessity to carry out an assessment of the resources that will be employed, together with the information that they provide and lack. This is relevant for any research project, but it is especially significant for LOD, since in most of the cases it builds upon connections established in already existing resources. The assessment carried out for this research revealed a certain degree of incompleteness that has been addressed by the generation of new information as explained in the following section.

6.2. New data collection and integration

The manual collection of data has been carried out in different ways depending on the origin and nature of the information to be integrated. As previously explained, the available LOD data has been consumed directly from *EDH* and *Pleiades* for the indices of epigraphy and settlements. Other data has also been collected manually from two different sources a) museum catalogues and other relevant resources surveyed in Chapter 4, and b) relevant scholarship which will be further discussed in this section. Once the background data was collected and encoded in the form of tabular data (using Google spreadsheets), it was then integrated and modelled as RDF, the recommended format for LOD.[114] This process was carried out through a data extraction pipeline written in the

[113] Regarding the issue of incompleteness see section 4.4.
[114] For a full summary of the source material included in ERUB see appendix 2.

Python programming language.[115] The extraction framework is available online in a GitHub code repository[116]. This repository contains:

- the scripts written in Python to integrate data originally collected in the spreadsheets as RDF
- the requirements to run the software as explained in the README.md file within the repository together with the running instructions, which I also explain below.

The code is configured in different individual extractors, one per data source and dataset to be produced, so that each extractor can be executed independently. The user can run one or more extractors in sequence or individually. Each extractor generates one RDF file in Turtle format that is stored in a folder in the same directory where the GitHub repository lies. Turtle code can be loaded onto any triple store of choice for subsequent querying via SPARQL. The extractors assume the user to have a command line prompt open inside the project's own root directory CulturalContactBaetica. From there, a single extractor (e.g., coinage) can be run as a standalone Python program:

```
python src/coinage.py
```

A single-entry point is also available for convenience in the form of a Baetica module. Again, from the CulturalContactBaetica directory, run:

```
python src/baetica.py [sourceNames]
```

[115] Python language reference, https://www.python.org (accessed August 2020).
[116] The repository can be accessed at: https://github.com/paulagranados/CulturalContactBaetica (accessed August 2020).

sourceNames is here a space-separated list of data sources. For example:

```
python src/baetica.py coinage sculpture settlements
```

When running the above command, the entry point inspects the extractors directory in the project for Python modules with the name. For instance:

```
extractors/coinage.py
```

Locates the coinage module and executes it, then same for:

```
extractors/sculpture.py
```

For each source there must be a Python module with that name inside the extractors package, so the user can simply drop new ones in there. Each extractor generates a (`.ttl`) file named after the source itself inside an out subdirectory of the current directory, as for example: `CulturalContactBaetica/out/coinage.ttl`. Existing Turtle files will be overwritten in this process.

The Python scripts work directly on the data collected in the spreadsheets, thus generating a series of Turtle files that are stored automatically in an output directory. In order to understand how each of the extractors work I shall now explain what kind of data has been collected, the vocabularies used to do so, and the scripts written. In order to avoid repetition, I will use examples taken from different case studies regarding coinage, sculpture or settlement data to illustrate each of the processes (Fig. 6.2).

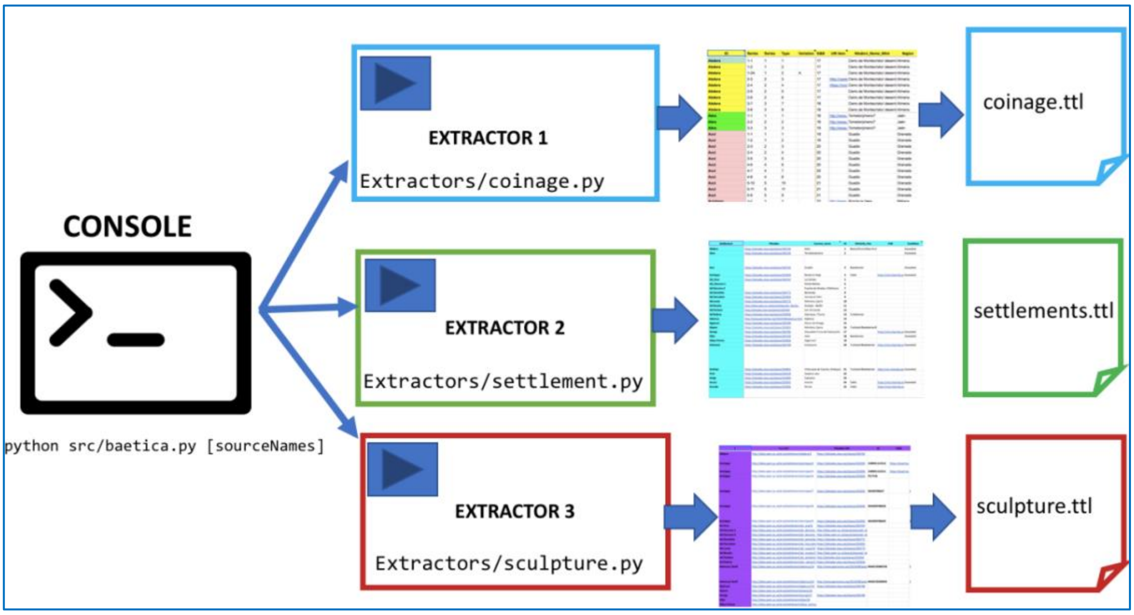

Fig. 6.2. Diagram of the workflow of the extractors.

6.2.1. New data collection

The set of background data were collected into three different online Google spreadsheets for a) coinage data b) sculptural data and c) settlements data.[117] These include data collected manually from primary or secondary sources modelled into RDF using both already-existing vocabularies and new concepts when necessary. One of the first steps for the collection of data manually involves the search for common standards that facilitate the later reuse and sharing of the new data collected. Several vocabularies have been developed in the last decade especially in the field of numismatics and archaeology, some of which, such as *EAGLE* and *NUDS*, were employed in the context of this work.

[117] See Appendix 2 for further reference

6.2.1.1 Numismatic data

The *Numismatic Description Schema (NUDS)* is the first standardisation system for the recording of numismatic data in table-related databases.[118] It was developed for common scenarios that may require the collection of numismatic information such as museum collection databases. Each scenario requires of specific fields to be completed, such as, in the case of a museum database, the object and the collection ID. Other standard fields are also contemplated such as descriptive information for the specimen, physical data, geography, authority, chronology, obverse, reverse, images each of which has its own specific set of vocabularies. I have used the *NUDS* schema to collect background data about all the pre-Roman and Roman mints that were active at some point from the 4th century BCE to the 1st century CE in the province of Ulterior-Baetica in the private Google spreadsheet. This has constituted a subset of data comprised of 616 different coin types and 77 mints. For the collection of this data, I consulted two of the main catalogues for Republican coinage in the province:

1. *Diccionario de Cecas y Pueblos Hispánicos* (M. Paz García-Bellido/Cruces Blázquez 2002): one of the most complete references for the study of both pre-Roman and Roman Republican mints in the Iberian Peninsula.
2. *Corpus Nummum Hispaniae Ante Augusti Aetatem*, (Leandre Villaronga 1994), collecting all the coins minted in the peninsula prior to the Augustan period and the inspiration for García y Bellido/Blázquez (2002). Specimens are collected in chronological order and clustered on the basis of their legends.

118 https://www.greekcoinage.org/numismatic-description-standard-nuds.html

Background data from these resources has been collected together with Spanish collections' catalogues accessed through the applications *CERES* and *Domus* and secondary scholarship regarding the classification of coins, series and types in each of the Ulterior-Baetica mints in a private Google spreadsheet 'CoinageData' following the *NUDS* recommendations. An example of this is given in Fig.6.3.

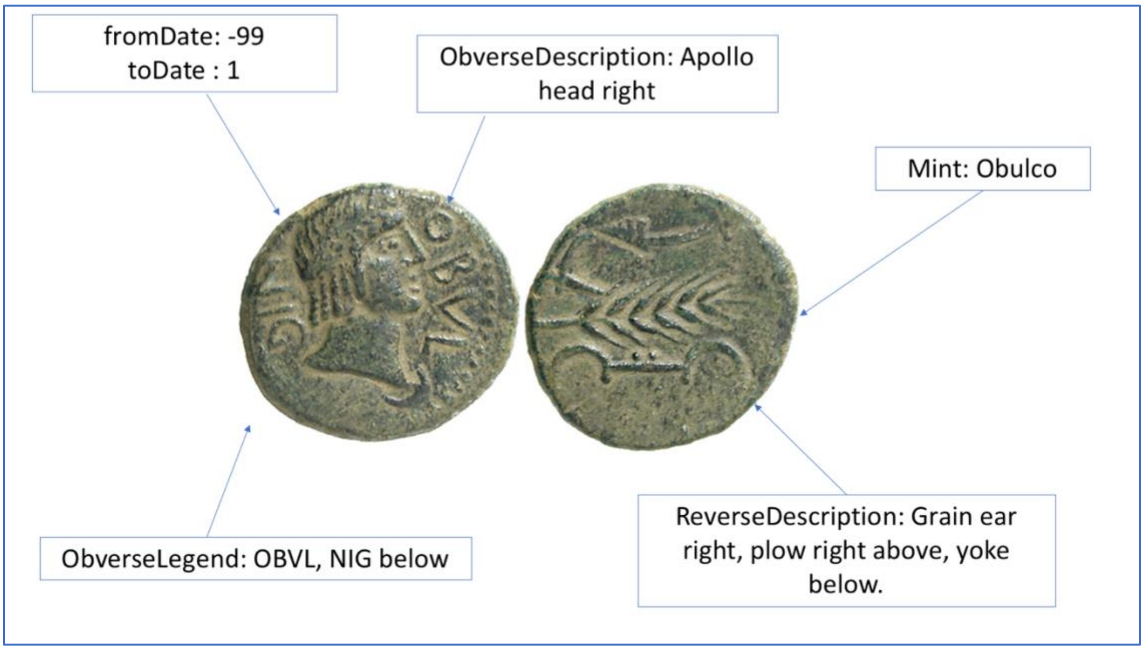

Fig. 6.3. Example of the encoding of a coin from Obulco (Porcuna, Jaén) as tabular data (CNH 351,4) (the author modified from coinproject). Reproduced courtesy of Jesus Vico S.A.

The data is therefore collected from each of the specimens and encoded in the spreadsheet table. The choices made in the data fields declared in each of the column headers will define the later modelling of the data as RDF, as we shall see in the following section.

6.2.1.2 Sculptural data

In the case of the sculptures, the corpus is dispersed across different museums and institutions all over Andalucía, each of which has its own catalogue. Although there are browser applications that allow the querying of different museum catalogues, computer accessibility to the data is not allowed and each of the records has to be accessed individually with the only possibility to export the data in PDF format. In this case, the data has been collected manually from each of the catalogue entries into a Google spreadsheet file with the name 'SculptureData'. 'SculptureData' collects information about all the sculptures and reliefs which were found or are somehow related to the 210 settlements identified in the province of Ulterior-Baetica.

Unlike numismatic data, there is plenty of catalogue information available online for sculpture. This information is provided by institutional databases that display individual records for each of the pieces stored. Because of this, it was not necessary to collect data manually from reference works such as the coin catalogues mentioned above, but it was necessary to extract the data directly from the web using exploratory queries. Queries can be made in the web applications that allow public access to the catalogues of the museums in Andalucía (where the majority of the pieces are stored) but also other institutions which also collect pieces of relevance such as for example the Museo Arqueológico Nacional (MAN) or the Musée de Saint-Germain-en-Laye (MSGL), both holders of some of the pieces of the Ibero-Roman set found in Osuna by the French Archaeological Mission in 1915.

The search for sculptures was carried out through exploratory queries in *CERES, Domus,* and the catalogue of MSGL, web applications that give access to the institutional catalogues of the museums in which the sculptures are collected. Other resources such as *Arachne* and *CVB* were also used. Once the relevant data was obtained, the background information was manually collected in the spreadsheet where it was encoded in the form of tabular data, paying special attention to features such as material, carving style or provenance, (Fig. 6.4).

Fig. 6.4. Example of the encoding of a sculpture from Torreparedones (Baena, Córdoba) (the author modified from: Domus dj030941).

6.2.1.3. Settlements data

The third spreadsheet, ‘SettlementsData’, collects information about the 210 settlements registered by *Pleiades* in the province of Ulterior-Baetica. Regarding standard recommendations for the collection of geographic information, Pleiades vocabularies for places[119] have constituted a useful guide to make standard choices for the column headers. Other resources were *DARE* field names and the *CVB* fields themselves. I collected information from *DARE*, *Pleiades*, *IAPH* and *CVB* in the spreadsheet to later integrate it as RDF data. An example for the type of information encoded can be seen in Fig. 6.5.

119 https://pleiades.stoa.org/vocabularies

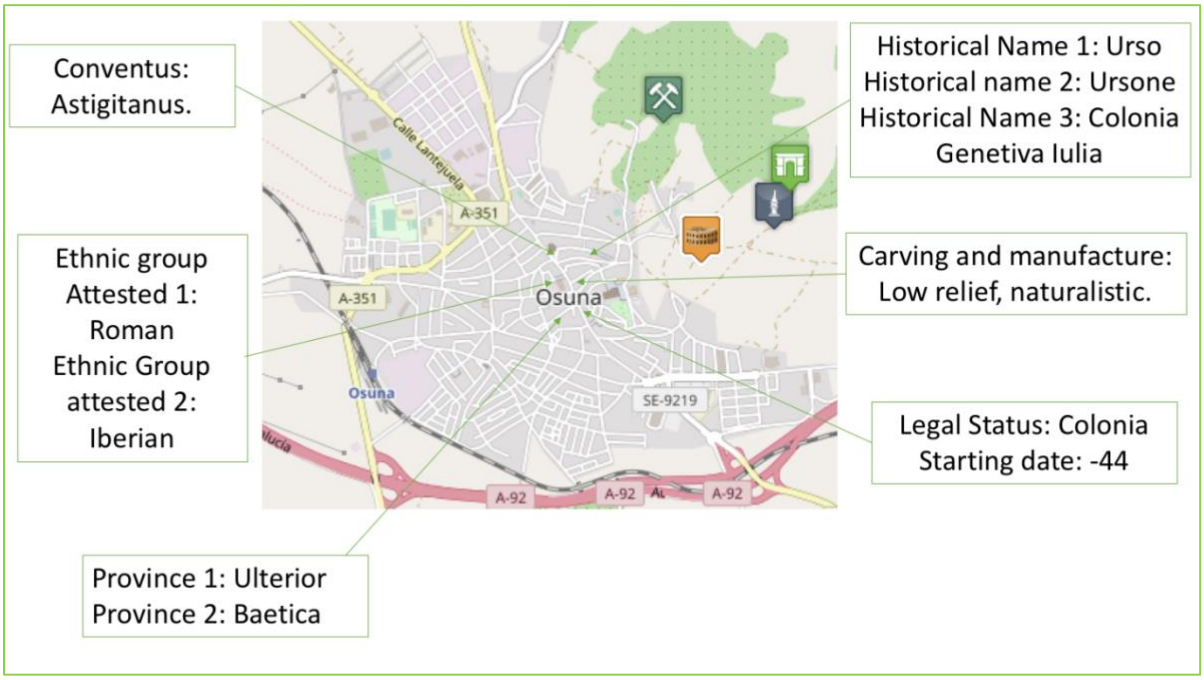

Fig. 6.5. Example of the encoding of the settlement of Osuna (Sevilla) (the author modified from: https://vici.org/vici/50365/) (accessed June 2020).

A series of exploratory queries were run in *Pleaides* and *DARE* to evaluate the quality of the data provided. The data was integrated in a local repository and queried using the SPARQL language to evaluate the quality of the information in terms of completeness, relevance and accuracy. An example of the querying is provided in the following Test Query 2 in Pleaides. The results are provided in Appendix 2.

Test query 2 in Pleaides: Retrieve all settlements in Ulterior Baetica with description and dates.

```
# Definition of the prefixes
PREFIX rdf:     <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX dcterms:     <http://purl.org/dc/terms/>
PREFIX geo:     <http://www.w3.org/2003/01/geo/wgs84_pos#>
PREFIX nm:    <http://nomisma.org/id/>
PREFIX nmo:     <http://nomisma.org/ontology#>
PREFIX skos:     <http://www.w3.org/2004/02/skos/core#>
PREFIX spatial: <http://jena.apache.org/spatial#>
PREFIX xsd:     <http://www.w3.org/2001/XMLSchema#>
```

```
# Select clause including the variables required
select ?name ?settlement ?description ?start_date ?end_date ?latitude
?longitude

# Where clause to define the graph pattern that the data need to
match to be retrieved. The subject needs to be a settlement with
description, Latitude, Longitude and name.
where {
  ?settlement a <https://pleiades.stoa.org/places/vocab#Place> ;
              dcterms:description ?description ;
                     geo:lat ?latitude ;
               geo:long ?longitude ;
               pleiades:hasName ?name .
# A second pattern requests the URI for the name and retrieves the
start date and end date from it.
  ?name a <https://pleiades.stoa.org/places/vocab#Name>;
        pleiades:start_date ?start_date ;
        pleiades:end_date ?end_date .
        }
Limit 100
```

Test query 2 retrieves 50 settlements from Pleiades with geographical coordinates, description and name. From each of the settlements it retrieves a name from which it also provides the start date and the end date. This query helps to understand the modelling of the data in Pleiades and the sort of information collected in the dataset. From the results provided in Appendix 2 we can see how Pleaides provides relevant data (i.e., the location of the places, chronological frame of occupation, evolution of the names, references and linked resources). However, the time-spans for the names are not entirely helpful and there is relevant data missing such as the Roman status of the places or the description the archaeological record.

After the exploratory queries run in *Pleiades* and *DARE* data before the collection, it was noted that several features of interest were missing, incomplete or inaccurate in the data.[120] In order to solve these issues, the missing or inaccurate information was completed, when possible, with data collected from the primary sources listed below:

De Bello Civili by Jiulius Caesar (50-40 BCE) (ed. Renatus du Pontet), amongst other works, narrates the first military campaign in Hispania. The text describes the establishment of some of the first *coloniae* in the territory as well as the evolution of certain settlements with the granting of Latin rights. It provides specific dates for the foundation of certain *coloniae* such as *Colonia Genetiva Iulia.*

Naturalis historia by Pliny the Elder (74 CE) includes a description of the Western Mediterranean with some detailed narrations of the towns of Ulterior-Baetica, their names, geographic locations and legal status.

Other secondary sources were also consulted for the list of settlements and settlements names collected in the database, such as *Historia Lingüística de la Península Ibérica en la Antigüedad: I. Preliminares y el Mundo Meridional Prerromano* by Javier de Hoz (2010). This text constitutes a fundamental resource for any researcher interested in the pre-Roman communities of the south of Spain. De Hoz develops a comprehensive account of all the settlements mentioned by classical authors in the south of the peninsula, their toponyms, possible origins and the ethnicities of the groups settled there.

[120] The features that were missing as well as their implications in the research method and the reliability of the resource have been explained further in section 6.1.3.

6.2.2. URI minting

W3C recommends the use of stable URIs as single identifiers for both concepts and objects. Since no prior URIs have been made available for these specific coin types, new ones had to be generated. The process by which new URIs are generated is called ‘minting’. In this case, minting consists of programmatically generating URIs from a column in the spreadsheet. Each script defines a function named ‘make_uuid’ which selects a base URI, taking advantage of the availability of access to resources in the data.open.ac.uk domain. For coin types, the base URI is: http://data.open.ac.uk/baetica/coin_type/. Using a conditional instruction, the function amends the mint name extracted from column 1 in the spreadsheet and a numerical ID to the URI, as for example: http://data.open.ac.uk/baetica/coin_type/abra/46997179.

```
uricache = {}
def make_uuid(item, graph, index = -1):
  base_uri = ‘http://data.open.ac.uk/baetica/coin_type/’
  uuid = None
  if 'ID' in item and item['ID'] and 'Series ' in item and
item['Series '] :
    locn = item['ID'].strip()
    series = item['Series '].strip()
    if locn in uricache and series in uricache[locn] :
      print('[WARN] there is already an item for {0} series
{1} : <{2}>'.format(locn, series, uricache[locn][series]))
    else:
      p = re.compile('\s*\(.+\)')
      hasz = abs(hash(locn + '/' + series)) % (10 ** 8)
      locn_sane = p.sub('', locn.lower().replace('/','--
')).strip().replace(' ','_')
      uuid = base_uri + locn_sane + '/' + str(hasz)
      if not locn in uricache : uricache[locn] = {}
      uricache[locn][series] = uuid
  else: print('[WARN] row ' + str(index + 2) + ': Could not
find suitable UUID to make an URI from.')
  return uuid
```

For the generation of the URI ID, the extractor concatenates the name of the mint with the series number (e.g., Abdera/1=2). Then the code takes this value and computes a hash code[121] out of it. After that, the code takes the last eight digits of the code —as it can be seen above in the modulo operation '% (10**8)'— and amends them to the mint name generating the final ID. This makes it reasonably difficult for a name to clash.

The Python script used to generate a URI for the coin types is similar to the ones used for the sculptural objects and the settlements. Regarding the sculpture spreadsheet, the code has a richer conditional logic in the sense that it tries to extract the Arachne or the museum ID for the object that appears in the URI collected in the spreadsheet and reuse it. When that is not possible, the code generates a new ID that is later used as the subject of the new generated triples that depend upon the data modelling process, as we shall see in the next section.

6.2.3. Data modelling

The URIs generated by the three extractors with the function 'make_uuid', are then related to the remaining features collected in the spreadsheet for the specific object using a semantic mapping that generates predicates and objects for each of the columns and rows in the spreadsheet. I will explain the following steps using as an example the coinage extractor, as it is the richest and most complete of the three. All of the extractors develop roughly the same functions and so coinage.py sets the pattern followed by settlements.py and sculpture.py. The three scripts are documented in the GitHub repository with (#) comments in each of the relevant commands.

[121] In Python, the hashcode() method takes a single parameter called object and computes a hashcode out of it. A hashcode is a numeric value used for the identification of an object. The number is not permanent in nature, but it is used to help lookup and insertion processes in data collections.

Each of the extractor scripts starts with commands for importing available libraries and modules designed for the modelling and integration of data in the RDF format, such as the RDFlib[122] package, a library designed to work with RDF in Python or SPARQLWrapper[123], a Python wrapper that executes remote queries in remote SPARQL endpoints. Another import is a local Google package, which is a Google API wrapper to access private spreadsheets. The list of imports can be seen in the GitHub files for the individual extractors and a sample of them is shown below:

```
import os, re
from json import JSONDecodeError
import rdflib
from rdflib import Graph, Namespace, URIRef, Literal, OWL, RDF,
RDFS, XSD
from rdflib.namespace import FOAF
from SPARQLWrapper import SPARQLExceptions, SPARQLWrapper,
JSON, N3
import unidecode
from urllib.parse import urlparse, parse_qs
from urllib.error import HTTPError, URLError
import commons.rdf as crdf
import google # Local module
```

After the imports the code defines the utility prefixes used along the code and creates the namespaces that will later be reused when the time comes to write the graph to Turtle or any other RDF serialisation.

122 https://github.com/RDFLib/rdflib
123 https://github.com/RDFLib/sparqlwrapper

```
CuCoO =
Namespace('http://www.semanticweb.org/paulagranadosgarcia/CuCo
O/')
crm = Namespace('http://erlangen-crm.org/current/')
dct = Namespace ('http://purl.org/dc/terms/')
geo = Namespace ('http://www.w3.org/2003/01/geo/wgs84_pos#')
osgeo = Namespace
('http://data.ordnancesurvey.co.uk/ontology/geometry/')
nmo = Namespace ('http://nomisma.org/ontology#')
nm = Namespace ('http://nomisma.org/id/')
rdf = Namespace ('http://www.w3.org/1999/02/22-rdf-syntax-
ns#')
rs = Namespace ('http://www.researchspace.org/ontology/')
skos = Namespace ('http://www.w3.org/2004/02/skos/core#')
spatial = Namespace ('http://geovocab.org/spatial#')
temp =
Namespace('http://data.open.ac.uk/ontology/culturalcontact/tem
p/')
```

W3C recommends the modelling of new data using already exiting vocabularies when possible. In order to ensure the reutilisation of already existing URIs, the code loads different vocabularies to be queried locally in the search for possible alignments in the concept mapping. In the case of the sculpture.py extractor, for example, the code loads the EAGLE vocabulary for materials to later use it to run a SPARQL query in it to search for URIs in EAGLE matching any materials in the spreadsheet.

```
vocabs
= {
        'material': 'https://www.eagle-
        network.eu/voc/material.rdf',
        'object_type': 'https://www.eagle-
        network.eu/voc/objtyp.rdf'
        }
```

In the case of the coinage extractor, the code loads the Nomisma vocabulary to parse it locally. In this regard, the first function defined in the script (lookup_nomisma) tries to find a string match for a given label in a selected Nomisma-controlled vocabulary, first looking for the existence of cached results and then if the label has not been found, it runs a SPARQL query on the Nomisma vocabulary which can be seen below:

```
SELECT DISTINCT ?X
      WHERE {
      ?x skos:inScheme <''' + type + '''>
      ;  skos:altLabel  ?l  FILTER(  lcase(str(?l))  =  '''  +
label.lower() + ''')
}'''
```

The Nomisma ontology[124] defines 32 classes and 57 properties, all of them specific to the numismatic domain, making it a fundamental resource for the modelling of concepts related to coinage in the ancient world, see for example (http://nomisma.org/ontology#Mint), defined as the 'Generic term for a place of manufacture of a coin or for the issuing city'.[125] Current and previous versions of the Nomisma ontology are available on the Nomisma website for download in its canonical form — RDF/XML — but also in other serialisations such as JSON-LD and Turtle.

After the imports and URI minting, the code then starts the mapping between a) the coin type, b) the spreadsheet data, and c) the vocabularies indicated in the code which have previously been defined. Through a conditional instructor the code processes the rows in the spreadsheet and adds it as the object of a triple in which the subject is the URI generated for the coin type and the predicate is the given vocabulary (Fig.6.6).

124 http://nomisma.org/ontology

125 http://nomisma.org/ontology#Mint

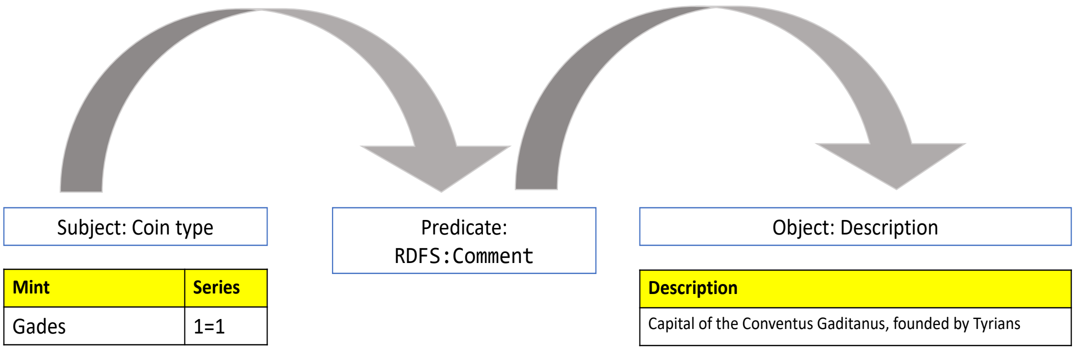

Fig.6.6. The modelling process between the coin-type and the description.

The following script takes the description column in the database, strips its content and converts it into an RDF comment of the URI given for the coin type:

```
if 'Description' in item and item ['Description'] :
  desc = item['Description'].strip()
  g.add( (sub, RDFS.comment, Literal(desc, lang='en') ) )
```

So that the result is a triple in which the subject is the URI of the coin type, the predicate is `rdfs:comment` and the object is the description of the mint that appears in the spreadsheet:

```
<http://data.open.ac.uk/baetica/coin_type/abdera/68336822>
rdfs:comment 'Phoenician colony from 8th ct BCE.'@en .
```

This sort of script is then used to map between the spreadsheet and the vocabularies used. The following table (6.1) shows some of the properties used to capture the numismatic data with different vocabularies.

MAPPING	
Data field	**Property**

Series and type	rdfs:label
Mint name	rdfs:label
Description	rdfs:comment
Material	nmo:hasmaterial
Authority	nmo:hasstatedauthority

Table 6.1. Properties used to capture the numismatic data with different vocabularies.

The modelling of the coin legends is, however, more complex. For epigraphic data, the legends on the coins are collected in the spreadsheet according to three different fields: first, the legend, second, the language, and third, the script, all of which need to be modelled into RDF. In order to do this, the code takes the URI minted before as the subject of the triples and relates it to the rest of the data using CIDOC-CRM properties. Since this is a lot of information to record at once, the code first recognises that the coin has an obverse and a reverse and that both obverse and reverse are visual items using crm:P65_shows_visual_item. Then, using the properties indicated below, the code relates each visual item of the coin type with its legend, language and script introduced in the triples as literals.

MAPPING	
Data field	**Property**
Obverse	crm:P65_shows_visual_item:
Obverse Legend	Nmo:hasLegend
Obverse Language	Crm:P72_has_language
Obverse script	Rs:PX_inscription_script

Table 6.2. Mapping between obverses and legends' data.

There are several ways of doing this sort of data modelling. The model developed here is merely a step in an incremental development process, but it is the more practical one for this type of data and the sort of information that needs to be modelled. This was mainly motivated by the necessity to incorporate high-level semantics into the RDF that describe the narratives of the coin types themselves. In order to do this, it becomes necessary to mint distinct URIs for: coin-type, coin obverse and reverse and the legends on each side, as seen in Fig. 6.7. This flexibility allows for a more complex querying of coins with different languages in both the obverse and the reverse as well as a more complex level of data modelling as we shall see further on in the chapter about data querying and visualisation.

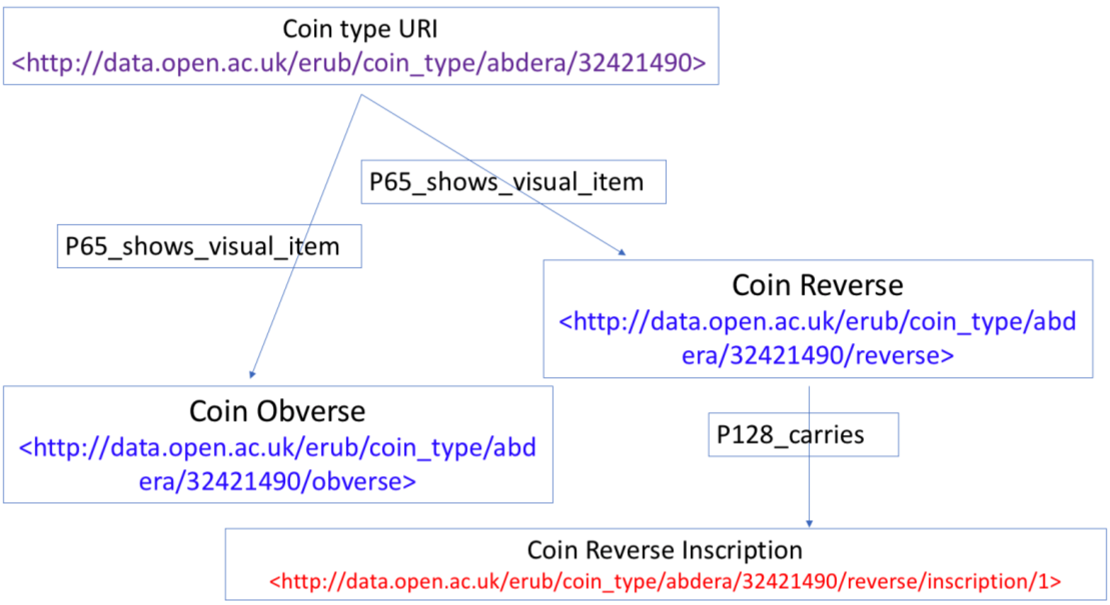

Fig. 6. 7. Diagram showing the hierarchy between URIs in the modelling of coin-types.

6.2.4. Alignment

LOD technologies allow mappings among different datasets by links embedded in the data or the schema itself. These links make it possible to state that two entities from different datasets have a certain level of similarity. This procedure enriches and contextualises the data as recommended by Berners-Lee's Linked Data principle 4 (Berners-Lee 2006), according to which a LD provider should deliver links to other datasets allowing the user to discover further information and queries to retrieve data across different repositories.

Different vocabularies provide properties to establish the connections between datasets. Links between datasets can be established on two different levels: a) the schema level, where links are established between the vocabularies upon which the dataset is built; and b) the instance level, where links are established between the entities that constitute the dataset (e.g., settlements, coin types, sculptures). The properties offered to map entities or concepts are provided by different knowledge representation schemas, SKOS and OWL being two of the most commonly used.

At the instance level, links are established between the individual instances in different datasets: for example, the connection between a coin represented in ERUB and a coin collected in the British Museum Semantic Dataset. The property (`owl:sameAs`) is normally used for aligning identical instances in the data. It indicates that the two URIs reflected in the triple refer to the same thing: this is taken into consideration by OWL reasoners. Another property normally used in alignments is (`rdfs:seeAlso`); however, this property is not considered strong enough to represent instance matching alignments by identity, which makes it more suitable for weak mappings, e.g., to point towards further relevant information.

Each of the extractors carries out a different sort of alignment depending on the data at hand and the datasets available online. In the case of coinage, the mappings between individual instances are drastically reduced, as there is very little data available online. These have been condensed to individual equivalences of coin types in the Spanish museums, the British Museum online catalogue and other web sources of relevance to numismatic collections as seen in the following data snippet for a coin from Abdera. For these matches the property used is (`rdfs:seeAlso`), because the data modelled in ERUB is a coin-type, whereas the URI provided records a specific coin, therefore they cannot be matched using other properties that indicate a higher level of alignment as they do not represent similar concepts.

```
<http://data.open.ac.uk/erub/coin_type/abdera/51878893>        a
nmo:TypeSeriesItem ;
    rdfs:label "Abdera coin series 2-4"@en ;
    crm:P65_shows_visual_item
<http://data.open.ac.uk/erub/coin_type/abdera/51878893/obverse
>,
<http://data.open.ac.uk/erub/coin_type/abdera/51878893/reverse
> ;
    nmo:hasDenomination "Half" ;
    nmo:hasStartDate "-99" ;
    nmo:hasEndDate "-1" ;
    nmo:hasFindspot
<http://data.open.ac.uk/erub/modernRegion/almeria> ;
    nmo:hasMaterial <http://nomisma.org/id/ae> ;
    nmo:hasMint <http://nomisma.org/id/abdera_hispania> ;
    nmo:hasObverse
<http://data.open.ac.uk/erub/coin_type/abdera/51878893/obverse
> ;
    nmo:hasReverse
<http://data.open.ac.uk/erub/coin_type/abdera/51878893/reverse
> ;

    rs:PX_object_type bm:x6089 ;
    cucoo:Series "2" ;
    cucoo:Type "4" ;
    cucoo:hasIconography
<http://data.open.ac.uk/erub/Iconography/punic> ;
    cucoo:hasLinguisticPhenomenon
<http://data.open.ac.uk/erub/coin_character/Monolingual> ;
    cucoo:hasMetrology
<http://data.open.ac.uk/erub/metrology/phoenician-turdetanian>
;
```

```
    cucoo:isAssociatedWith
<http://data.open.ac.uk/erub/cultural_identity/Phoenicio-
punic> ;
    rdfs:seeAlso
<https://www.numisbids.com/n.php?p=lot&sid=359&lot=4> ;
    rdfs:seeAlso
<https://www.britishmuseum.org/collection/object/C_1844-0115-
169>.
```

Another form of linkage implemented in coinage.py is not carried out by the alignment of the same item in different datasets, but by the inclusion of existing URIs for the dataset item in the RDF itself. This type of linking uses already-existing URIs for the items in the dataset instead of using strings or generating new ones and therefore it fulfils both the fourth Linked Data principle and the fifth star in the Linked Data star model (Berners-Lee 2006 edited in 2010). An example of this method is used in sculpture.py to find equivalences of the authority figures and deities represented in the coins in other datasets such as DBpedia. This method applies Natural Language Processing (NLP) and Named Entity Recognition (NER) through DBpedia Spotlight[126]. DBpedia Spotlight is a tool that automatically annotates mentions of DBpedia resources, providing semantic linking for information sources to the LOD cloud through DBpedia. Using NLP and NER, the spotlight recognises the names of concepts or entities mentioned in the text (e.g., 'Melqart') and subsequently matches these names to unique identifiers (e.g., http://dbpedia.org/resource/Melqart). An example of this can be seen in the following triple:

```
<http://data.open.ac.uk/baetica/coin_type/abdera/11873131/obve
rse> a crm:E36_Visual_Item ;
  rdfs:label 'obverse of Abdera coin series 1=2A'@en ;
```

126 https://github.com/dbpedia-spotlight/dbpedia-spotlight/wiki/Introduction (accessed August 2020).

```
  nmo:hasPortrait <http://dbpedia.org/resource/Melqart> ;
  dct:description 'male head right with club'@en .
```

The use of NER to perform entity linking with DBpedia, although proven to be accurate (Mendes et al. 2011), can generate links for which closer matches may be found for the specific context. While it is the domain researcher's responsibility to assess and refine such matches, evaluating the accuracy of DBpedia Spotlight falls beyond the remit of the case study. However, it is a goal of this contribution to ensure that the best possible parameters - namely the least general classes in the DBpedia ontology that match the desired entity types - are provided. While small-scale projects will allow a manual verification of the matches that are recommended, this is obviously less feasible in large-scale endeavours. To minimise the occurrence of false positives in larger datasets, the best practice involves a careful verification of the parameters before the matching process, possibly with a two-step verification process including a demo of the sort of matches that will be carried out. Very large-scale projects should also allow for the possibility to consider 'acceptable' a small portion of false positives in their processed data, when the number of correct matches can greatly enrich the quality of the information. It is also important to emphasise that no automated NER process will be fully accurate and some form of domain expert verification will most likely be necessary.

At the concept level, as explained earlier, numismatics was one of the first disciplines to adopt LOD technologies for the establishment of common vocabularies and standards for data modelling. For this purpose, as mentioned above, the extractor loads relevant vocabularies that can be queried for similar concepts such as for example *Nomisma*. Concept alignment can also be performed in the ontology itself by stating that certain concepts defined in the specific ontology are the same as other concepts in other vocabularies. This sort of alignment is normally made through the SKOS properties (`skos:closeMatch`) and (`skos:exactMatch`). The latter was intended for thesauri which deal more closely with the notion of concept.

In the case of sculpture data, there are no LOD data sources that provide this sort of information for the Iberian Peninsula. Arachne is the only repository that provides URIs for some of the pieces coming from Baetica, however, the sample is not comprehensive and, as explained in Chapter 4, the resource is neither entirely functional nor implemented as LOD. Because of this, the alignment between instances in different datasets is quite limited. One way to get around this is to point to the records of that same object in other databases as a reference by using (`rdfs:seeAlso`). In that way, the dataset is enriched, and the user/developer is encouraged to explore further however, yet without compromising the quality of the original set of data.

Finally, regarding settlement data, the possibilities of alignment between gazetteers are much more abundant than between archaeological/heritage data repositories themselves. As demonstrated in Chapter 5, gazetteers seem to have taken the lead in using LOD technologies for the publication of ancient world geodata. There are several resources that provide stable URIs and information for most of the relevant settlements, for example, *Trismegistos places*, *Pleiades* or *DARE*. By establishing links between the settlements in the Baetica dataset and the records collected in other repositories, the data is exponentially enriched by the new triples. As explained before, properties like (`skos:closeMatch`) and (`skos:exactMatch`) allow this sort of concept alignment. It is important to make sure that the level of similarity between concepts is proportional to the sort of property used, to avoid establishing wrong links within the data. Below there is an example of the modelling of a settlement in the ERUB dataset using SKOS to map it with similar items in other gazetteers:

```
<http://data.open.ac.uk/baetica/Urso> a
<http://www.semanticweb.org/paulagranadosgarcia/CuCo06/Settlem
ent>
      ; rdfs:label 'Urso'@en ;
      ; gn:historicalName 'Ursone'@ib
      ; skos:exactMatch
<https://pleiades.stoa.org/places/256503> ,
<http://imperium.ahlfeldt.se/places/22432> ,
<https://vici.org/vici/3687/> ,
<https://www.trismegistos.org/place/26236> ,
<https://www.wikidata.org/wiki/Q586018> .
```

6.4. The ERUB dataset

The ERUB dataset is comprised of almost 2 million RDF triples that approximately describe 600 coin-types, 400 sculptures, 200 places and 300 inscriptions (within the larger EDH dataset) studied in this thesis. The RDF has been integrated from data coming from two different sources. First, data collected online from the resources reaccessed in Chapter 5 (*EDH*, *Nomisma* and *Pleiades*), and second, data collected manually and translated into RDF using Python scripts, as explained earlier. ERUB is hosted in a local triple store supported by the Fuseki server. Apache Jena Fuseki is an open-source SPARQL server that allows the querying of graph databases. The triples have been uploaded to Fuseki and deposited in four differently named graphs (Fig. 6.8).

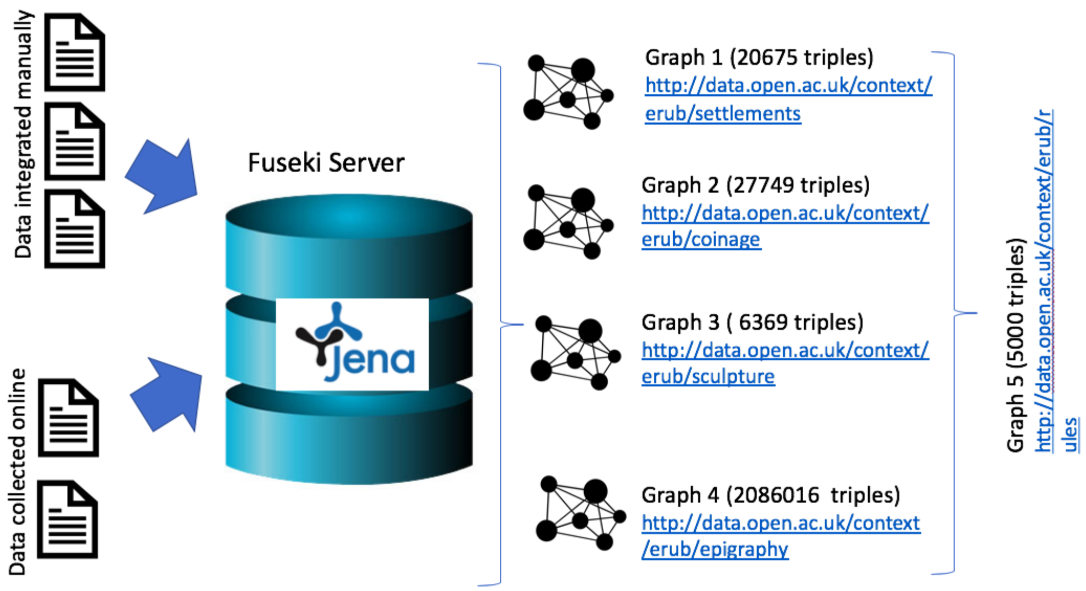

Fig. 6.8. The data uploading process in Fuseki.

In Fuseki, one file location called ‘directory’ is used to store the RDF dataset. By default, the datasets uploaded are hosted as a single graph unless different named graphs are specified in the uploading process. Named graphs are stored in a collection of quad indexes that can be queried individually. Fuseki has been configured for the default graph to be the union of the named graphs. So, by default, the queries run on all the data are available unless an explicit named graph is specified.

The ERUB dataset consists of 4 named graphs, each of which hosts a specific subset of the RDF (sculpture, settlements, coinage and epigraphy). The graphs can be queried through the Fuseki SPARQL endpoint as seen in Fig. 6.9.

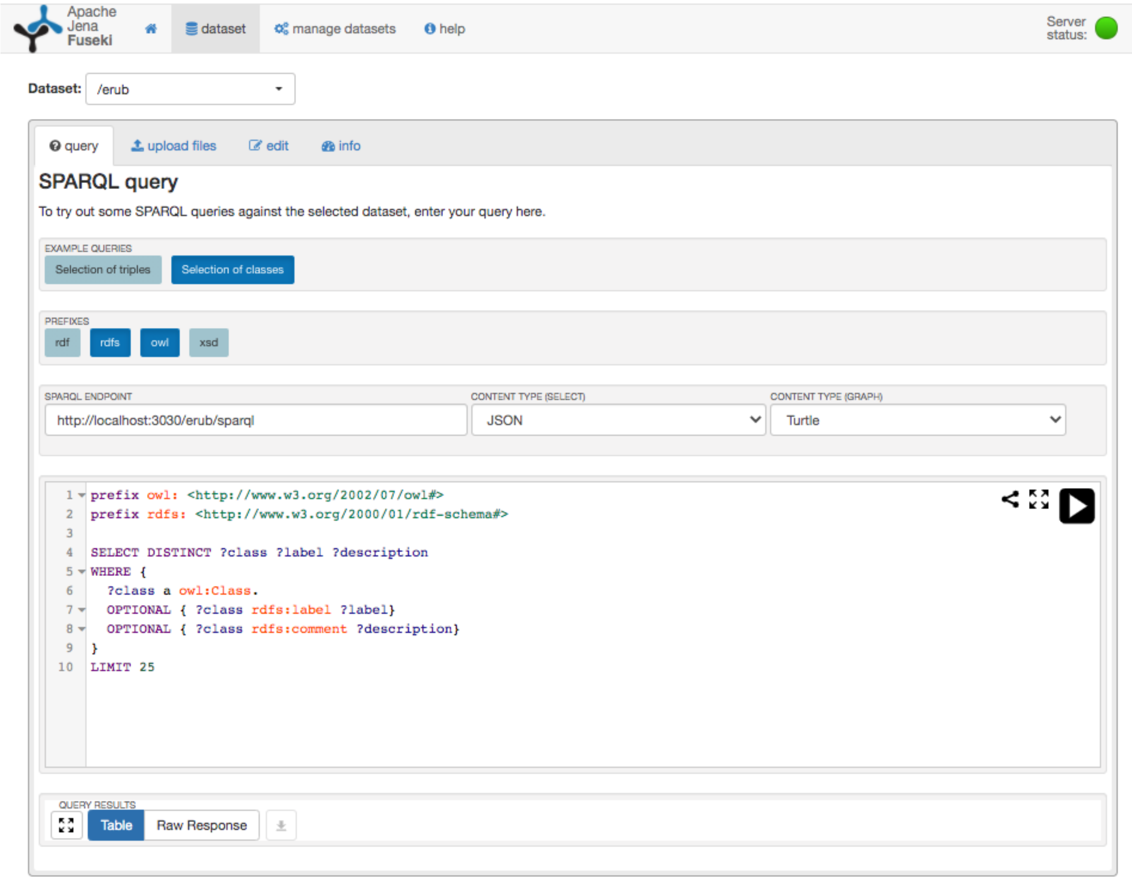

Fig.6.9. Screenshot of the Fuseki Server SPARQL endpoint interface showing the example query 'selection of classes.'

In the following sections I shall explain the main features of the ERUB dataset to further explain the process and potentialities of SPARQL querying.

Graph 1: Settlements

Graph 1 hosts the settlements data from ERUB in Fuseki. The graph consists of the data collected from *Pleiades* (whose features were explained in the previous sections) and the settlement data integrated manually with Python scripts using properties from the *Nomisma* ontology, RDFS, SKOS and the ontology for Cultural Contact (CuCoO). The vocabularies available already as part of the Semantic Web have proved their usability in the representation of the data they were modelled for. Nevertheless, there are certain concepts specifically treated in this research that these vocabularies do not reflect. The necessity to model concepts related to the cultural domain, and especially cultural contact dynamics, have motivated the generation of an ontology for cultural contact. The procedure for the development of CuCoO, the ontology for Cultural Contact, will be explained in the following chapter. Nevertheless, one of the benefits of LOD is that it enables a dynamic workflow of data integration that does not require a fully-defined model from the beginning but that allows the evaluation of the process and the necessity for data types along the way. This allows the user to start integrating the data from the beginning. In this section, the use of the CuCoO ontology will be reflected in the RDF samples displayed with the prefix CuCoO, but the particularities of the model will be further developed in the following chapter.

Below is a sample of the RDF generated for the settlement data:

RDF SAMPLE 6.3. SETTLEMENTS ACCI/3.

```
@prefix cucoo: <http://www.semanticweb.org/paulagranadosgarcia/CuCoO/> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix skos: <http://www.w3.org/2004/02/skos/core#> .

<http://data.open.ac.uk/erub/settlement/acci/3> a
cucoo:Settlement ;
    rdfs:label "Acci"@spa ;
    cucoo:hasCondition "Excavated"@en ;
    cucoo:hasEndDate "300" ;
    cucoo:hasEthnicity "Bastetanian"@en ;
    cucoo:hasLegalStatus
<http://data.open.ac.uk/erub/legalstatus/acci_A >;
    cucoo:hasMint <http://nomisma.org/id/acci> ;
    cucoo:hasName
<http://data.open.ac.uk/erub/settlement_name/acci>,
<http://data.open.ac.uk/erub/settlement_name/col_iulia_gemella
>,
        "Guadix"@es ;
    cucoo:hasStartDate "-45" ;
```

```
    cucoo:inConventus
<http://data.open.ac.uk/erub/administrative_region/Comventus_C
arthaginensis?> ;
    cucoo:inProvince <http://data.open.ac.uk/erub/post-
Augustean_province/Hispania_Tarraconensis>,
        <http://data.open.ac.uk/erub/pre-
Augustean_province/Hispania_Ulterior> ;
    cucoo:isAssociatedWith
<http://data.open.ac.uk/erub/cultural_identity/Roman> ;
    rdfs:comment """The colonia Ivlia Gemella Acci was founded
by César in 45 BC, shortly after the Battle of Munda to house
the veterans of the Regio prima vernacula and Regio Segunda.
The choice of enclave obeys several reasons:
It was located close to the scope of action of these legions
(Cúrtuba, Ulia, Munda, Urso, etc).
There was also no colonia in the Bastetania.
On the other hand, it was logical to think that a point to the
South was chosen since those of the vernacular were natural of
the province, and those of the second felt like such. In
addition, the rich fertile valley of Guadix met the necessary
conditions to cover the ends of the hill and was well
connected by two roads that passed through there."""@en ;
    rdfs:seeAlso <https://en.wikipedia.org/wiki/Guadix>,
        <https://guiadigital.iaph.es/bien/inmueble/196957> ;
    skos:closeMatch <https://www.wikidata.org/wiki/Q244324> ;
    skos:exactMatch
<http://imperium.ahlfeldt.se/places/22608>,
        <http://vici.org/vici/3737>,
        <https://pleiades.stoa.org/places/265765>,
        <https://www.trismegistos.org/place/26586> .
```

This sample collects the information about the settlement of Acci, current Guadix, Granada. As one can see, the RDF of the sample is written in Turtle syntax, the triples end with a full stop preceded by a space that makes it easier for the user to read and understand the data. The record for Acci is preceded by some prefixes. Triples define the name of the prefixes used in the data and the URIs they stand for. So, for example, the prefix 'CuCoO' stands in for the namespace URI (http://www.semanticweb.org/paulagranadosgarcia/CuCoO/).

In the sample (`http://data.open.ac.uk/erub/settlement/acci/3`) is the subject of the triples. In RDF, all subjects must be URIs. In ERUB each record is identified by a URI minted programmatically using Python. The URIs incorporate the scheme ‘http:’ as recommended by the W3C, followed by the ‘data.open.ac.uk’ a specification of the open data repository which will host the data. This is then followed by the URI path constituted by the name of the dataset ‘erub’, the type of the record ‘settlement’, the name of the place ‘acci’ and a numerical ID ‘3’. The subject of the triple is then attached to several predicates using different properties that match the town of Acci to data regarding current and past features of the settlement as well as archaeological metadata.

ERUB RDF for settlements collects several pieces of data. First, using (`rdfs:comment`) it records the history of excavations at the site and the site itself. It also models the chronology for the occupation of the site prior to and after Roman rule. The analysis of the archaeological evidence distributed across the different strata in each of the sites has been used to establish the chronology of the arrival of different groups. Dating the first settlement of people on site and the successive arrivals of different ethnic groups can help in understating of the history of the settlement itself. The database of IAPH (Instituto Andaluz del Patrimonio Histórico) provides information about the dating of the archaeological remains found in most of the settlements. I have created a table of equivalences to translate these periods into numeric references following the NUDS recommendations for modelling time data and I have collected them together in the time sheet. These have been converted into new RDF triples that collect the different dates of occupations and modelled using two properties provided by the CuCoO ontology (`cucoo:hasStartDate`) and (`cucoo:HasEndDate`). In this case, the dates of the settlements have been modelled using new properties generated in CuCoO. These properties provide more flexibility in terms of registering the 'start_date' and 'end_date' of an entity and are not linked to a numismatic or an epigraphic context.

The RDF generated also deals with cultural associations. The material culture of the communities attested in the area has been analysed by scholars to establish the provenance of the different groups associated with the settlements. Most of the settlements provide evidence for the establishment of one or more groups over time. The property `(cucoo:isAssociatedWith)` connects the settlement with the groups it has been related to over time. In this way, we can infer relationships with other settlements or even different artefacts which have been associated with the same collective identity in ERUB.

The territorial jurisdiction of a province over certain towns can also be very helpful in terms of querying a specific set of the data and it can also be revealing in terms of cultural contact, since the cultural manifestations of the groups established in a specific province can be compared to those of the groups established in others. Provincial borders in the Roman Empire tended to change over time. Furthermore, the variation of geographic boundaries can certainly make things more difficult in terms of data modelling. As we have seen, initially, Roman administration established only two provinces in the Iberian Peninsula, Hispania Citerior (North-East) and Hispania Ulterior (South) that later Augustus' administration divided into Baetica, Lusitania and Tarraconensis. Within the province of Baetica there were also four different *conventus* each of which had its own capital. In most of the cases, Pleiades RDF lacks a declared connection between the settlements and the ancient provinces they belonged to (e.g., https://pleiades.stoa.org/places/265762/turtle). In this respect, DARE RDF goes a step further by adding a (dare:province) property (http://imperium.ahlfeldt.se/places/16830.ttl) followed by the literal 'Hispania Baetica', although this can still be implemented. This is important here because ERUB is the first database of archaeological data from Baetica to disambiguate the different provinces that the settlements belonged to.

Literals represent literal values (e.g., strings or numbers) and they can only be used as properties or objects of a triple, never as a subject. There are two types of literals: plain and typed. Plain literals are associated with a language tag (e.g., 'Seville'@en) whereas typed literals are associated with a data type which is defined by an XML schema and can correspond to dates, integers etc. Literals normally bring new meaning into the LOD cloud (for example adding new information that was not already there). Literals are just values; they cannot be further described but just specified in operational terms. In the case of DARE data, 'Hispania Baetica' does not provide any further information about the province as for example its foundation date, the territories that it included or the time when it ceased to exist. Literals are normally used when the property or object of the triple are not an already-existing URI or it is not worthwhile to mint a new URI because it would not add extra value to the dataset (as for example with personal names).[127]

One of the main purposes of this research apart from the definition of concepts related to cross-cultural interaction, is the understanding of Roman terminology of vital importance for the history of the colonial encounter in the south of the Iberian Peninsula. Because of

[127] It normally depends on the requirements of the project to decide upon the use of literals or URIs, however, the latter is normally the best choice as they can be used to provide further research context into the denomination. See https://godot.date/home for a gazetteer on calendar dates.

this, a further specification of the Roman provinces of Hispania is fundamental. Ironically, *Pleiades* does provide a URI for the concept of Hispania Baetica itself, although it is not linked to the settlements related to the province (see https://pleiades.stoa.org/places/981510). Other resources that include a URI for the province are *Nomisma*, *EDH* and *DBpedia*. *EDH* URIs provide a numeric ID for the province and some documentation when visited online, however not quite illustrative (e.g., https://edh-www.adw.uni-heidelberg.de/edh/geographie/900030) on the other side, the HTML rendition of DBpedia URIs does provide further contextual research on the given concept (e.g., http://dbpedia.org/page/Hispania_Ulterior). Because of this, both references have been included in the RDF. Modelling the administrative jurisdiction gets even more complex when looking at settlements that have belonged to different provinces over time, (e.g., http://imperium.ahlfeldt.se/places/16841.ttl). As explained in Chapter 3, Castulo first belonged to Hispania Ulterior and then became part of Hispania Tarraconensis under Augustus. *DARE* uses the same property (`dare:province`) to model the last province to which Castulo belonged, thus ignoring the history of the site which can be quite revealing in terms of cultural contact. To solve this, I have minted URIs for the different provinces and *conventus*, to be later related to each settlement with the CuCoO properties `inProvince` and `inConventus` and this enables me to query those settlements that belonged to a specific *conventus* or province or even those that changed their territorial demarcation over time, as shown in the following RDF sample (6.4.) from Castulo:

RDF SAMPLE 6.4. CASTULO/KASTILO/63

```
<http://data.open.ac.uk/erub/settlement/castulo/_kastilo/63> a
cucoo:Settlement ;
  rdfs:label ‘Castulo/ Kastilo’@en ;
  cucoo:inConventus
<http://data.open.ac.uk/erub/administrative_region/border> ;
  cucoo:isAssociatedWith ‘Oretani’@en,
    ‘Roman_republican’@en ;
  cucoo:hasLegalStatus
<http://data.open.ac.uk/erub/legalstatus/castulo/_kastilo_A> ,
<http://data.open.ac.uk/erub/legalstatus/castulo/_kastilo_B> ;
  cucoo:hasName
<http://data.open.ac.uk/erub/settlement_name/castulo>,
    ‘Castulo ‘@es ;
  cucoo:inProvince <http://data.open.ac.uk/erub/post-
Augustean_province/Hispania_Tarraconensis>,
    <http://data.open.ac.uk/erub/pre-
Augustean_province/Hispania_Ulterior> ;
```

In Hispania Ulterior-Baetica many places received a new nomenclature after Roman conquest, when the settlements were founded or re-founded with a new legal status. Using a ternary operator in the script, the data reflects the legal status of the place and the time when the new legal status was received, if known as shown in the following data snippets.[128]

RDF SAMPLE 6.5. CASTULO/KASTILO/63

```
<http://data.open.ac.uk/erub/legalstatus/castulo/kastilo_A>   a
sit:TimeIndexedSituation ;
    rdfs:label "Castulo/Kastilo was legally a Civitas_foederata
at some point"@en ;
    cucoo:hasStatusDenomination cucoo:Civitas_foederata .
<http://data.open.ac.uk/erub/legalstatus/castulo/kastilo_B>   a
sit:TimeIndexedSituation ;
```

[128] Ternary operators in Python are also known as conditional operators. They generate a specific product based on a condition being true or false.

```
    rdfs:label   "Castulo/Kastilo   was   legally   a   Municipium
Castulense at some point"@en ;
    cucoo:hasStatusDenomination cucoo:Municipium_castulense.
```

```
RDF SAMPLE 6.6. CARTEIA/62
<http://data.open.ac.uk/erub/legalstatus/carteia_A>          a
sit:TimeIndexedSituation ;
    rdfs:label       "Carteia       was       legally       a
Colonia_Latina_Libertinorum as of -171"@en ;
    sit:atTime "-171"^^xsd:gYear ;
    cucoo:hasStatusDenomination
cucoo:Colonia_Latina_Libertinorum .
```

As it can be seen in the triples from Castulo and Carteia, the ternary operator generates first a URI for the legal status of the settlement e.g., `<http://data.open.ac.uk/erub/legalstatus/carteia_A>` to then associate this URI to a label, a time '`sit:atTime "-171"^^xsd:gYear`' and a denomination '`cucoo:Colonia_Latina_Libertinorum`'.

Finally, the predicate (`rdfs:seeAlso`) is used to point to alternative records of the same settlement in similar databases. This sort of linkage is called alignment between databases and in ERUB this is made using two different properties depending on the level or reliability of the connection. Thus, (`rdfs:seeAlso`) is the weakest connection because no level of equivalence is presumed. The property (`skos:closeMatch`) also used in the modelling indicates a higher level of compatibility between the subject and the entities linked in the RDF. Other possibilities are (`skos:broadMatch`) for broader matchings and (`skos:exactMatch`) for exact compatibility. In this way, through the

Content Negotiation tool implemented on the HTTP protocol the user agent can communicate with the server and specify the version of the resource to be obtained.

Graph 2: coinage

Graph 2 hosts the coinage data from ERUB in Fuseki. The graph consists of data on the mints collected from Nomisma (whose features were mainly explained in Chapter 5) and the coinage data integrated manually. Below is a sample of the RDF generated for the representation of the coin type Abdera/54480683:

RDF SAMPLE 6.7. COINAGE ‘Abdera coin series 1-2’

```
@prefix crm: <http://erlangen-crm.org/current/> .
@prefix cucoo:
<http://www.semanticweb.org/paulagranadosgarcia/CuCoO/> .
@prefix nmo: <http://nomisma.org/ontology#> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .
@prefix rs: <http://www.researchspace.org/ontology/> .

<http://data.open.ac.uk/erub/coin_type/abdera/54480683> a
nmo:TypeSeriesItem ;
  rdfs:label ‘Abdera coin series 1-2’@en ;
  crm:P65_shows_visual_item
<http://data.open.ac.uk/erub/coin_type/abdera/54480683/obverse
>,

<http://data.open.ac.uk/erub/coin_type/abdera/54480683/reverse
> ;
  nmo:hasDenomination ‘Half’ ;
  nmo:hasEndDate ‘-1’ ;
  nmo:hasFindspot
<http://data.open.ac.uk/erub/modernRegion/almeria> ;
  nmo:hasMaterial <http://nomisma.org/id/ae> ;
  nmo:hasMint <http://nomisma.org/id/abdera_hispania> ;
  nmo:hasObverse
<http://data.open.ac.uk/erub/coin_type/abdera/54480683/obverse
> ;
```

```
  nmo:hasReverse
<http://data.open.ac.uk/erub/coin_type/abdera/54480683/reverse
> ;
  nmo:hasStartDate '-200' ;
  rs:PX_object_type bm:x6089 ;
  cucoo:hasIconography
<http://data.open.ac.uk/erub/Iconography/punic> ;
  cucoo:hasLingualCharacter
<http://data.open.ac.uk/erub/coin_character/Monolingual> ;
  cucoo:hasMetrology
<http://data.open.ac.uk/erub/metrology/phoenician-turdetanian>
;
  cucoo:isAssociatedWith
<http://data.open.ac.uk/erub/cultural_identity/Phoenicio-
punic> ;
  cucoo:similarTo <http://nomisma.org/id/obulco> ;
  rdfs:comment 'Phoenician colonia from 8th ct BCE.'@en .
```

The sample above displays data about the coin type 2 minted in Abdera within the series 1. Again, the prefixes are defined at the top of the graph and there is one subject to which the rest of properties are related. In this case, the RDF reflects: the label given to the object using `(rdfs:label)`, numismatic metadata about the coin type itself using *Nomisma*'s properties such as `(nmo:hasDenomination)`, `(nmo:hasMaterial)` or `(nmo:hasMint)`. Approximate dates from the time when the coin was minted are also modelled using `(nmo:hasStartDate)` and `(nmo:hasEndDate)`. As it has been explained above, the modelling of tombstone data in ERUB has been done using already existing vocabularies when possible. Because of this, the Nomisma convention for dates has also been used for sculptures and is also used by *EDH* for the modelling of epigraphic chronological data, as we shall see later. This choice has made the modelling process easier because of a previous familiarity with the data and the modelling ontologies provided by the resources surveyed in chapter 5.

The sample also includes the modelling of iconographic data and the legends on both sides of the coin. As explained before, URIs can work as subjects or objects of a triple. In this case, in order to model the data recorded on the obverse and reverse, the script generates a URI for both sides of the coin.[129] This makes the model more flexible and allows the recording of further information about both sides. The URIs minted are later connected to the cultural features associated to them (e.g., images or languages). Then such features are associated with different cultural identities using (`cucoo:isAssociatedWith`). This feature will be further explained in the next chapter.

Graph 3: sculpture

Graph 3 hosts the sculpture data from ERUB in Fuseki. In contrast with the previous cases, this graph only contains data collected manually using Python scripts and available ontologies such as RDFS, CIDOC-CRM and CuCoO. Below there is a sample of the RDF generated for the previously shown votive offering from Torreparedones:

RDF SAMPLE 6.8. SCULPTURE ituci_virtus_iulia/dj030941

```
@prefix crm: <http://erlangen-crm.org/current/> .
@prefix cucoo:
<http://www.semanticweb.org/paulagranadosgarcia/CuCoO/> .
@prefix dct: <http://purl.org/dc/terms/> .
@prefix epi: <http://edh-www.adw.uni-
heidelberg.de/edh/ontology#> .
@prefix geo: <http://www.w3.org/2003/01/geo/wgs84_pos#> .
@prefix lawd: <http://lawd.info/ontology/> .
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#> .

<http://data.open.ac.uk/erub/sculpture/ituci_virtus_iulia/dj03
0941> a cucoo:sculpture ;
  rdfs:label ‘limestone sculpture’@en ;
```

[129] See Fig. 6. 7 for the URIs hierarchy in the modelling of coin-types.

```
  epi:hasPerson <http://data.open.ac.uk/erub/depiction/person-
262> ;
  crm:P1_is_identified_by
<http://data.open.ac.uk/erub/sculpture/ID/DJ030941> ;
  crm:P2_has_type <https://www.eagle-
network.eu/voc/objtyp/lod/224> ;
  crm:P45_consists_of <https://www.eagle-
network.eu/voc/material/lod/67> ;
  crm:P50_has_current_keeper
'Museo_Arqueologico_/_Etnologico_de_Cordoba_'@sp ;
  lawd:foundAt
<http://data.open.ac.uk/erub/settlement/ituci_virtus_iulia/118
> ;
  cucoo:hasEndDate '-100'^^xsd:gYear ;
  cucoo:hasStartDate '-200'^^xsd:gYear ;
  dct:description '''Heady ex-voto fragment carved in beige
limestone.
The head presents carved the typical hair of the Iberian
melena - helmet that frames the face. The facial features are
characterised by their appreciable classicism in the lipsy
nose and something less in eyes (two ovals)y which have hardly
been worked on although their dimensions are outstanding.
The difference in treatments of existing surfaces is striking
since the face has been perfectly polished while the hair is
rough and rough.
On the forehead of the head is an incised Latin graphite 'Dea
Caelestis' which possibly alludes to the deity to which it was
dedicated.'''@en ;
  cucoo:depicts 'feline_head'@en ;
  cucoo:hasCarving 'low_relief'@en ;
  cucoo:hasDepth '6'^^xsd:int ;
  cucoo:hasHeight '6/7'^^xsd:int ;
  cucoo:hasInscription
<http://data.open.ac.uk/erub/sculpture/ituci_virtus_iulia/dj03
0941/inscription> ;
  cucoo:hasTechnique 'sculpted'@en ;
  cucoo:hasWidth '7'^^xsd:int ;
  cucoo:museumCulturalContext
<http://data.open.ac.uk/erub/cultural_context/Iberian>,
    <http://data.open.ac.uk/erub/cultural_context/Roman> ;
  rdfs:seeAlso
<http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta
.do?acron=MAECO&musid=7&ninv=DJ030941&volver=portal&k=torrepar
edones&tipoBusqueda=simple&lng=es> ;
  geo:location <https://pleiades.stoa.org/places/265938> .
```

The sample displays data about the sculpture identified with the URI (`<http://data.open.ac.uk/erub/sculpture/ituci_virtus_iulia/dj030941>`), a limestone votive offering found in a local sanctuary in Cordoba. In this case, the URI path consists of the object type ‘sculpture’, the place of origin ‘Ituci_Virtus_Iulia’, and the museum inventory number ‘dj030941’. Again, the prefixes are defined at the top of the graph and there is one subject to which the rest of properties are related. In this case, we can see how several properties from *Nomisma* have been used for the modelling as well as CuCoO and CIDOC. As can be seen, the piece has been dated between 200 and 100 BCE, it has been identified by the museum as a votive offering from Torreparedones. It comes from a settlement called Itucci Virtus Iulia and it is currently hosted by the Museo de Museo Arqueológico y Etnológico de Córdoba.

In the core data, it can be seen that the piece has two cultural associations. These associations are those attributed by the museum and are directly justified in the data by the CuCoO property (`cucoo:MuseumCulturalContex`). The associations made by the museum are reasoned in the catalogue, but they are not directly specified in the data so the user cannot distinguish immediately why a specific object is considered ‘Phoenician’ or ‘Iberian’.

In this case, an important feature of ERUB is that sculpture data incorporates specific URIs for the persons represented in the objects. Using a property taken from the EDH ontology, which is specified with the prefix ‘epi’, the RDF reflects that the sculpture has a person which is also disambiguated and identified with a URI. The URI in this case is similar to the ones mentioned before constituted by the word ‘person’ followed by a numerical ID. This operation allows the RDF to have more semantic potential, since, in this way, we can then use such URI as the subject for further triples that will connect the person represented in the object to a certain cultural or gender identity, clothes or even accessories as seen in the sample below:

```
RDF SAMPLE 6.9. depiction/person-262
```

```
<http://data.open.ac.uk/erub/depiction/person-262>   rdfs:label
'limestone sculpture depicts a person'@en ;
  cucoo:hasGenderIdentity 'female'@en ;
  cucoo:hasHairStyle 'hairdress/helmet'@en ;
  cucoo:wears 'hairstyle/helmet'@en .
```

As it can be seen in the RDF samples above (6.3 and 6.9) the 'gender identities', 'hair style' or 'ethnicities' have been modelled as literals instead of RDF resources. The CuCoO ontology uses controlled vocabularies from the British Museum to refer to the languages used in coin legends and inscriptions when possible. However, the creation of a vocabulary for other more explicit concepts such as gender, clothes or hairstyle has not been implemented. The reason for this is related to first the lack of consensus in some of the fields (e.g., gender identities) and second, the specificity of the terms in some of the cases, which are deeply related to the dataset at issue and their specific features within the different cultural groups examined (it is not the same to model a 'helmet' in the Iberian culture than a 'helmet' in the Punic fashion), but also, because of the lack of a large enough corpus of data and sufficient exploration to allow the generation of standard terminologies for each the ethnic groups. Therefore, the literal values, when they occur, are mainly intended as placeholders for values that can be refactored as concepts in a controlled vocabulary at a later time. The following chapter (7) includes an explanation on each type of properties, including the expected datatype and its implications in terms of data modelling.

Regarding ethnic identities, the initial plan contemplated the generation of a set of classes in CuCoO for the different ethnicities as the extension of (`cucoo:EthnicIdentity`). However, after the integration of the source data it soon became apparent that it was not possible to create a list of ethnicities before completing an in-depth examination of the information. Because of this, the final decision was to populate the extension of (`cucoo:EthnicIdentity`) with instances generated from the data itself, instead of producing a more constrained vocabulary for the ethnicities. This offered a pragmatic solution for the generation of ERUB and allowed a quicker and less complex modelling process and a deeper exploration of the diversified formulation of 'ethnic identities' in the source databases and scholarship. The procedure followed should not be taken as a permanent recommendation but as a pragmatic stopgap for the purposes of this thesis only. Ultimately the ideal scenario will imply the normalisation of the literals into a (e.g., SKOS-based) vocabulary, which will help correcting errors and inevitable inconsistencies with uncontrolled values. Developments like this will be taken into account for future iterations of the dataset.

Finally, another important feature of the ERUB sculptural data is the inclusion of information about epigraphs inscribed on the sculptural objects. Using a similar mechanism to that employed for the coins (because coins also carry epigraphs in the form of legends) a URI is generated for the inscription recorded on each of the artistic objects which is later enriched with further descriptions about the inscription itself. The following triples provide information about the inscription on the sculpture from Torreparedones (Baena, Córdoba):

```
RDF SAMPLE 6.10. ituci_virtus_iulia/dj030941/inscription
```

```
<http://data.open.ac.uk/erub/sculpture/ituci_virtus_iulia/dj03
0941/inscription> a epi:inscription,
    cucoo:CulturalContactTrait ;
  rdfs:label ‘inscription of limestone sculpture’@en ;
  crm:P128_carries ‘DEA CAEL (estis) IVS (sit)’^^xsd:string ;
  crm:P72_has_language
<http://collection.britishmuseum.org/id/thesauri/language/lati
n> ;
  rs:PX_inscription_script
<http://collection.britishmuseum.org/id/thesauri/Script/latin>
;
  rdfs:comment ‘‘‘Front of the head. Incision/ Capital/ Latin/
Cultual.
DEA CAEL (estis) IVS (sit) [This piece alludes to the cult of
the Dea Caelestis/ although it may also be related to the cult
of Isis Caelestis, deity located in the environments of Italica
in Seville and Baelo Claudio in Cádiz.];’’’@en .
```

The RDF shows that the subject of the triples is the URI for the inscription made in the sculpture, which is later connected to different predicates related to the text it carries, the language of the text, the script and an explanatory comment of where the inscription is located and its possible meaning.

In general terms, the RDF reflects the main features identifying the artefact, together with metadata about the sculpture. Using CuCoO properties, features such as the sort of carving, the material or the presence of an inscription are modelled as cultural traits that can reveal some sort of evidence of the cultural associations between the artefact and other groups.

Graph 4: epigraphy

Graph 4 hosts the epigraphy data collected from EDH uploaded to Fuseki. EDH provides data dumps of the whole dataset in their data repository. These have been downloaded and re-uploaded to the Fuseki server constituting an important set of triples of which only the inscriptions coming from the Roman province of Hispania have been considered in the SPARQL querying.

As explained in the data snippet shown in section 6.1.1. the modelling of the data developed in EDH is quite similar to that carried out in ERUB. It relies on three main ontologies: Dublin Core terms, Nomisma and the EDH (epi:) ontology among others. The property (epi:hasPerson) from the EDH ontology, has been used in the modelling of tombstone data in ERUB related to the people depicted in sculptures and also the names recorded in inscriptions. As emphasised above, EDH also uses properties from the Nomisma ontology, LAWD, SKOS and FOAF which have also been used in the modelling of tombstone data for the rest of graphs, given therefore internal consistency to the dataset.

EDH only collects Latin inscriptions from Hispania, therefore the data ingested from EDH will only provide inscriptions in Latin and not in other Paleohispanic languages. These inscriptions can be related to the rest of items collected in ERUB by common references to places (settlements), communities, languages or scripts and by the chronology.

6.4. Technical complexities for a non-technical expert

The processes described in this chapter may embody certain technical complexity for non-technical experts especially regarding the modelling and integration of background data as LOD. While this chapter has shown the procedure followed for the generation of ERUB in this specific case study, it has never aimed to be a recommendation of best practices. Instead, this chapter aims to provide an example of possible solutions for similar projects that may find similar difficulties. For each of the processes described, different approaches could have been taken and the procedures described are only one of the possible solutions.

In the case of data collection, I have carried out a manual collection of information from each of the resources surveyed. This approach is very time consuming, as it requires the collection of each of the data items separately, but it does not require the acquisition of complex skills such as web-scraping, only a certain level of familiarity with the repository and the SPARQL language querying. Furthermore, it allows a better assessment of the information collected, a greater familiarity with the data and a better assessment of the resources from the user's perspective.

In the case of the data modelling and integration, the procedure implied a higher level of complexity. One of the most common tools for the generation of RDF data by non-technical users is Web-Karma. Web-Karma is an open-source information integration tool that enables non-expert users to integrate data from varied sources and model it according to one or several ontologies through a graphical user interface. The advantages of using web-Karma include that it is open source, it has an easy user interface, and it does not require the user to learn programming languages. Nevertheless, it does require one to learn how to use the tool and it does not provide complete autonomy to the user as other programming languages do. Because of this, the final decision for this research was to carry out the data modelling and integration process by the generation of programming scripts written in Python. To do this, it was necessary to acquire a certain level of autonomy in the use of programming languages. This was accomplished by a series of training activities on open e-learning platforms such as Coursera, DataCamp and also by following the Digital Classics training on Python at the Sunoikisis program.[130] It was also fundamental to count on Python experts who could check the scripts for possible errors or possibilities of improvement. Obviously, this process was time-consuming, and it required the development of several new skills not just in terms of using a programming language but also in ontological modelling and the libraries available in Python to model and integrate RDF data. The whole process took two years to complete, which also included the exploration of the data available and the assessment of the resources integrated. Although this solution was more complex and time-consuming than initially expected, it allowed greater autonomy in the modelling of the data by not relying on an external software, but by allowing the generation of a tailor-made data modelling script for specific purposes.

The issues of time and technical complexity definitely speak to the viability of employing this methodology in other contexts and research groups for which this method may not be the best solution. There are certain concerns that should be taken into account when considering the implementation of LOD technologies in any research project. These concerns should be:

1. Time investment: how much time will be allowed for the project, making sure that there is specific time allowed for the implementation of LOD technologies, including the generation of the dataset with all the steps mentioned above and the

[130] https://www.coursera.org/, https://www.datacamp.com/, https://github.com/SunoikisisDC (accessed August 2020).

training if necessary. This time allowance should also contemplate 'contingency time' for processes that may take longer than initially expected.

2. Technical skills: an assessment of the technical skills required for the development of the project should carried out, taking into account the skills that will have to be acquired during the process of implementation, the training available and potential costs.
3. Technical support: either if the project depends on an independent researcher or a team of investigators, it is recommendable to count on external researchers that can provide technical support to the processes developed. Depending on the funding, these may be external developers that may help with specific difficulties or collaborators that can provide long-term support for specific processes.
4. Data and projects available: Before the generation of ERUB, it was necessary to conduct a careful assessment of the resources available that could contribute data to the project. This was fundamental to understand the amount of data that could be ingested in ERUB but also the quality of the modelling process and the information that was missing. As it was noted before, despite some projects advertise themselves as implemented with LOD, this is not always true, and it is important to verify which projects or data will contribute to the project.

6.5. Conclusions

This chapter explained the manual collection of data and the decisions made in the modelling and integration of such information in the form of RDF, the common format adopted by LOD. The modelling process described in the lines above relies mainly on existing vocabularies provided by important collaborative projects in different domains such as the *Nomisma.org* ontology, in the case of numismatics, the EDH ontology and the *EAGLE* vocabularies for materials, among others. The use of several vocabularies has in this case proven the impossibility of embracing a unique model completely, but the application of several schemata can bring richness and accessibility to a dataset.

The vocabularies used in the modelling have proved to be useful in the representation of the contextual or 'tombstone' data upon which the Baetica dataset is built, but they have also demonstrated their ineffectiveness in the modelling of other sorts of information, in this case related to the cultural contact domain and cultural contact dynamics. One of the advantages of LOD is that it enables an organic process of data integration in a sort of 'pay as you go' method in which the user does not need to 'advance' much time and effort at the beginning. Modelling can start with a workable ontology that collects a (possibly incomplete) set of necessary concepts to later incorporate more complex notions that might require of more specific vocabularies for their representation. In this way, the data stream never ceases even though the need to refine the modelling schema may appear at some point, as it happened with the modelling of cultural phenomena in the Baetica dataset.

Dissatisfaction with the existing domain ontologies for the capture of data related to cultural phenomena indicated above has demonstrated the need for a vocabulary that deals with cultural contact concepts and this necessity has motivated the generation of the Cultural Contact Ontology (CuCoO). CuCoO brings in a new set of classes and concepts that explore, first, different ways of perceiving cultural contact in the data and, second, the possibilities for modelling cultural contact phenomena. The next chapter explains how the CuCoO ontology was built, upon which methodology it relies and the rationale that lies behind its constitution.

Finally, it is also important to underline the technical complexity that the processes developed embodied for a specialist without a technical background, not only in the understanding of how LOD technologies work, but also in acquiring the necessary technical skills in programming languages to translate the tabular data collected into RDF. At the beginning of this process, the possibility of using other available toolkits was considered, nevertheless it was decided to use Python language for the amount of capabilities that it incorporated into the modelling process. In any case, there are certain issues to be taken into account before considering the implementation of LOD, these are: time investment, technical skills, technical support and potential data available for consumption.

Chapter 7: The Cultural Contact Ontology (CuCoO)

Overview

Chapter 6 was a comprehensive account of the procedures followed for the consumption of LOD and the collection and incorporation of background data gathered ad hoc and integrated as RDF. This chapter focuses on the data modelling process including the rationale and the methodological guidelines that support the design and development of an ontology for cultural contact (CuCoO). CuCoO is an ontology that allows the retrieval of cultural-enhanced data as an interconnected series of traits as opposed to a catalogue or an index of objects which tend to present data in a linear format. CuCoO has been conceived as a means for the critical evaluation of the methodology and not as the definitive vocabulary for the modelling of cultural contact. Instead, CuCoO allows the critical examination of the research questions by allowing the retrieval of cultural-enriched information from ERUB, the purpose for which its classes and properties have been conceived. In this chapter, I shall further explain the classes and properties upon which CuCoO has been built and the decisions behind the conceptual modelling process.

7.1. A network of objects: the rationale

The development of semantic technologies has allowed computers to semantically model the relationships among objects. Using Linked Data technologies, it is possible to cluster similar objects in relation to place, time or events by establishing connections amongst them that a computer can interpret. Traditional archaeological databases tended to describe formal characteristics of the objects (e.g., time, place, and provenance). With the implementation of LOD technologies, this process went a step further allowing the establishment of digital connections between the objects (either tangible or virtual) and the places associated with them.[131] These connections have grown in the last years to relate not just objects and places but also events, people and literary evidence enriching the geographical, historical and literary context of the object itself. The ontology for cultural contact (CuCoO) goes beyond the description of formal characteristics of objects, to the identification of cultural influences.

The idea of a network of interconnected objects based on shared cultural influences is not new. One of the first scholars to emphasise the underlaying relationship among all man-made objects was Alfred Gell in his well-known *Art and Agency* (1998). In this theoretical model, Gell claimed that all objects belong to one big network of materiality in which each element constitutes an instance. His ideas pointed out the agency of the material object itself, and the necessity to recover it in anthropological analysis. One of the main themes that Gell focused on is the understanding of how things are culturally linked together and belong to one same and bigger corpus. According to the scholar, all art works and objects generated through history belong to one same assembly, as a spatio-temporally dispersed set that interacts together due to design decisions, human action or manufacture. A set that is not materially unified but consists of several spatially separated elements each of which acts within and as a result of its unique micro-story.[132]

The corpus of multi-ethnic material preserved from Ulterior-Baetica is a compendium of physically different objects that emerges not from a centralised phenomenon but from a

[131] The best example for this is the Pelagios project.

[132] Gell's work considers the micro-story of objects consisting of the micro social events and social interactions in which the object participates actively. In Gell's own words: 'The simplest way to imagine this is to suppose that there could be a species of anthropological theory in which persons or social agents are, in certain contexts, substituted by art objects (Gell 1998, p.5) Artefacts are therefore considered by Gell as active participants of their own micro-stories.

process of historical aggregation derived from a network of social relationships amongst indigenous communities and colonial groups. The relationships between the different communities shape the way in which the different groups create cultural meaning among them; however, this is not only represented in human relationships but also in those between the community and the material culture itself. In the same way that any social individual is the result of their relationships with other persons, objects evolve through time and interact in different ways within different hands. Because of this, objects can testify to cultural interaction, and therefore, the confluence of cultural influences that through human activity have left their imprint in the macro-story of the object. These interactions among people and objects generate the cultural meaning that is embodied and enacted by the object itself.

Chris Gosden and Yvonne Marshall (1990) have written about the biography of objects and the agency of objects not as passive vessels of cultural meaning but as elements that take part in the generation of that meaning. In their view, the agency of the object relies on the way in which it can affect the lives of peoples in an emotional, intellectual, social and physical way. Objects act through people and should be considered as dynamic entities that have significance for the individuals around them. An example of this is Tringham's (1994,1995) study of a set of Neolithic houses. In Tringham's perspective, the houses are single dynamic entities that play a role in the life of their Neolithic inhabitants and generate their own biography. Their biography is engendered through time as a product of their interaction with their inhabitants and the memories that this interaction generates. In parallel to Tringham's ideas, Gell's model of the house also focuses on the interaction of the house with its occupants. In order to understand the connection between the house and the community living in it, Gell explores the Maori meeting houses in Polynesia. For this, Gell relies on the work of Roger Neich who photographically documented Maori meeting houses to understand the connections among the different wall paintings displayed in them. The houses were constructed by the Maori community of North Island between 1550 and 1930 to exhibit communal power over the other members of the group. All of the houses present similar floor plans and were designed to embody the status, technical skill and ancestry of the group in charge of the construction (Gell 1998).

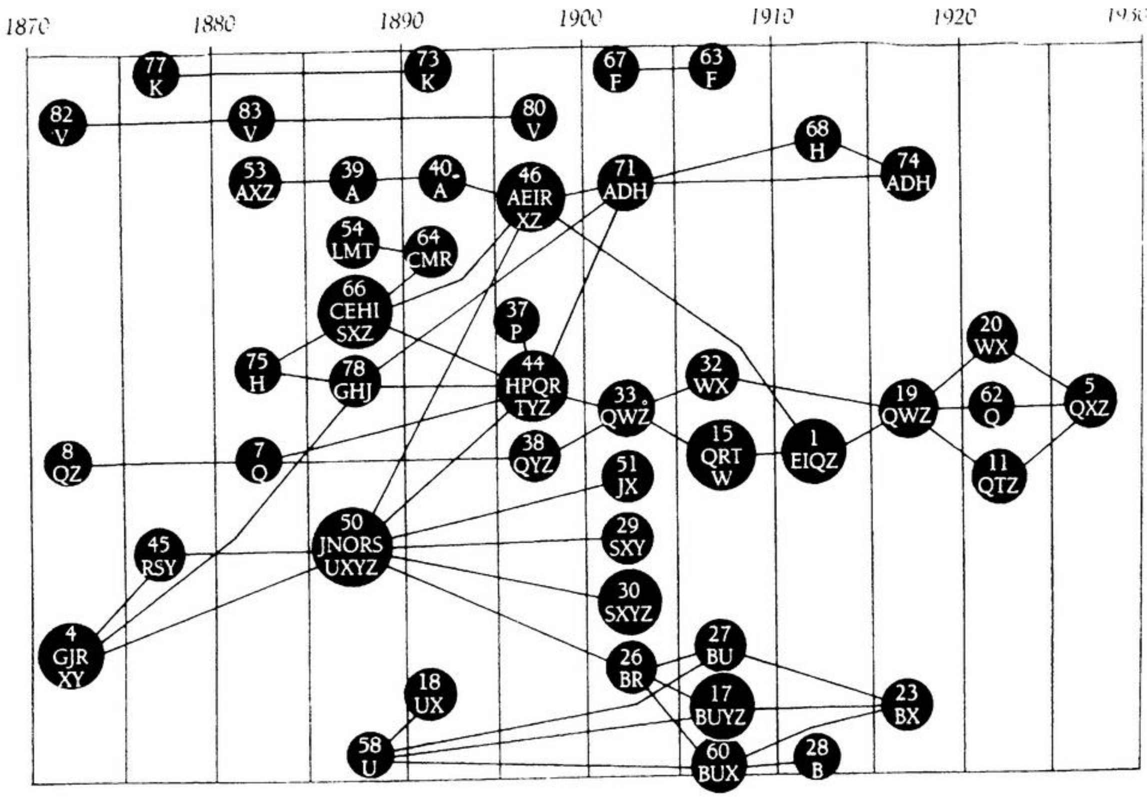

Fig. 7.1. Graph made by Neich (1996, Table 14: 'Transmission of selected figurative painting traditions in the meeting houses of the Maori of North Island') and reproduced by Gell (1998) to illustrate the transmission of figurative painting traditions amongst the houses. Reproduced courtesy of Roger Neich and Auckland University Press.

In the table developed by Neich (Fig.7.1) the numbers represent the houses and the letters represent the painting traditions that are identified in the houses. The similarities amongst the painting traditions are understood as evidence for the cultural interaction between the different households on the basis of the transmission of the same drawing patterns. The houses are considered by Gell as expressions of the cultural system of the community that give voice to a plural and collective agency. In his view, entering a house should be understood as the act of entering a communal mind, a body that has entries and exits, therefore the houses, according to Gell, should be considered not as symbols of the community living but as indexes of agency.

It is important to denote the difference between Neich's research and what LD technologies can do. In his work, Neich represents the transmission of cultural traits such as figurative painting. In order to understand the potential connections established between the different communities that inhabited the houses and the houses themselves, the scholar identifies a cultural trait, in this case paintings, and follows its transmission amongst the different houses. On the other hand, LD can be used to represent connections between entities with shared characteristics (e.g., two coins that were produced at one same mint). The cultural contact ontology (CuCoO) aims to allow the modelling of cultural traits in the objects in order to explore potential cultural connections between the entities identified in a graph dataset implemented with LD technologies.

CuCoO allows the exploration of this approach in the archaeological record of early Roman Spain from which the ERUB dataset has been generated as explained in Chapter 6. The interconnections among different objects in the corpus can be typified and examined similarly to that of the houses, not just looking at paintings but also carving, style, material and other cultural-related features. Coins, inscriptions or sculptures can be linked together based on cultural influences that can be inferred from the data according to the rules established by the CuCoO schema. The relationships among the objects may generate a network of interconnected entities upon cultural influences, a similar concept to that represented by Neich and reproduced by Gell. In this way, the semantic representation of information allows knowledge retrieval as a connected network of ideas, instead of in a linear format such as indexes or catalogues in which records are hierarchically structured and disjointedly represented.

As opposed to an indexed or hierarchical catalogue, CuCoO provides the possibility to model the ERUB dataset as an interconnected network of objects on the basis of common cultural traits. To understand this through an example, let us go back to the already mentioned votive offering from Ituci Virtus Iulia (Torreparedones, Baena, Córdoba: Fig. 6.4. Object DJ030941). When looking at the catalogue information about the object in Domus, one can see background data such as the inventory number (`DJ030941`), the type of object (`votive offering`), the provenance (`Santuario de Torreparedones`), material, dimensions etc. There is also a description which provides information about the carving, a section on the inscriptions made on the object and a reasoned classification that supports the cultural context (`'Hierro Final. Iberromano'`) and its dating (`200 BC- 100 BC`).[133] In this case, the catalogue does not provide links to similar objects or items related by period or cultural context. Adding links to similar objects or concepts into the catalogue page could be easily accomplished by implementing it with hyperlinks to point the user towards related pages within the same repository as it has been already

[133] To see the catalogue entry for the object (http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MAECO&musid=7&ninv=DJ030941&volver=portal&k=torreparedones&tipoBusqueda=simple&lng=es) Last accessed August 2020.

done in similar museum catalogues.[134] In any case, if we wanted to retrieve the information, we would get a catalogue card with some hyperlinks in the best scenario. Instead, the implementation of Linked Data technologies, allows the data provider to go a step further in the way in which the data is stored and interconnected. LD allows the storage of the raw data as a set of interconnected items, this is, a graph dataset or knowledge graph of interrelated items that can be retrieved as interconnected knowledge. If we query the ERUB dataset for all the data related to Object DJ030941, we will get a table (7.1.) which provides not only the tombstone data that can also be obtained from the catalogue but also the typified connections (predicates) that have been established between the statue and the rest of statements (objects). Through SPARQL querying, the user can retrieve information about the object itself or any of the data items connected to it.

predicate	object
rdf:type	cucoo:sculpture
geo:location	pleaides:265938
rdfs:label	limestone sculpture
dct:description	Female-head votive offering fragment carved in beige limestone. It presents the typical Iberian carved hair that frames the face. The facial features are characterised by their appreciable classicism in the lips and nose and something less in eyes (two ovals) which have hardly been worked on although their dimensions are outstanding. The difference in treatments of existing surfaces is striking. The face has been perfectly polished while the hair is rough. On the forehead there is an incised Latin graphite 'Dea Caelestis' which possibly alludes to the deity to which it was dedicated.
rdfs:seeAlso	domus:DJ030941
lawd:foundAt	erub:ituci_virtus_iulia/118
nomsima:hasStartDate	-200
nomisma:hasEndDate	-100
epi:hasPerson	erub:person-262

[134] See for example the British Museum Online collection (https://www.britishmuseum.org/collection/object/X__3910) or La Plateforme du patrimoine, Ministère de la culture française (https://www.pop.culture.gouv.fr/notice/joconde/50010015889) (Last accessed August 2020).

crm:P2_has_type	eagle:224
crm:P45_consists_of	eagle:67
cucoo:hasCarving	low_relief
cucoo:hasDepth	6
cucoo:hasHeight	6/7
cucoo:hasTechnique	sculpted
cucoo:hasWidth	7
cucoo:depicts	feline_head
cucoo:hasInscription	erub:dj030941/inscription
crm:P1_is_identified_by	erub:DJ030941
crm:P50_has_current_keeper	Museo_Arqueologico_/_Etnologico_de_Cordoba_

Table 7.1. Data provided by a query for information about object dj030941 in ERUB.

In Table 7.1., we can see similar background data to that provided in the catalogue, but in this case, the information is stored as typed connections between raw data fields which in some cases lead to a string of text (e.g., 'feline head') and in other cases lead to a URI which can provide further information about the object (e.g., http://data.open.ac.uk/erub/sculpture/ituci_virtus_iulia/dj030941/inscription). These links between objects are the basis of the network of information that is collected in the graph.

From the data retrieved before in table format, it was difficult to see how the data items were actually interconnected in the knowledge graph. In Fig. 7.2. we can see a visualisation of how the data is interlinked by common nodes. In the center of the diagram is object *DJ030941* which is then related to the rest of the data items (nodes) by properties (edges). These properties come from CuCoO but also from other vocabularies that have been reused when possible.[135] The diagram shows how three different networks are retrieved when querying for the data related to one single object. The larger circle at the

[135] The reuse of vocabularies in the modelling process is best practice since it prevents from the creation of ontologies that already exist, it improves the internal consistence of the dataset, and it saves time in the modelling.

top represents the network of tombstone data generated around the object, the two smaller circles at the bottom represent two different networks, one generated around the inscription recorded on the sculpture (left) and the other generated around the data about the ‘person’ depicted in the votive offering. As it has been explained before, this visualisation shows only a little section of the graph, corresponding to the data retrieved by one single query. One could keep adding data to this network by exploring the connections depicted, to generate a much larger graph of information.

As explained in Chapter 5, when two digital objects are aligned in LD, they automatically inherit each other’s properties and associated types. Therefore, the alignment brings in a whole new set of information allowing contextualisation of the data and the inference of new links among the objects.

Fig. 7.2. Diagram of data retrieved for object dj030941. Green nodes: strings of text, pink nodes: external URIs and rdf type, blue nodes: URIs in ERUB.

7.2. Modelling cultural contact in archaeological evidence

To explore the theoretical framework provided by the Cultural Contact theory explained in Chapter 3 and test the methodology, explained in Chapters 5, 6 and 7, I have developed CuCoO. CuCoO is a tool that provides a set of concepts and relationships to understand cultural contact in Ulterior Baetica from the 3rd century BCE to the 1st century CE. It allows the researcher to specify and declare a certain number of assumptions about the domain at issue which are being applied in this specific investigation. The application of CuCoO concepts and reasoning to identify and semantically annotate cultural traits such as materiality, language, iconography or place of production within different archaeological objects contained in the ERUB dataset allows the modelling of cultural contact itself as well as the establishment of potential cultural connections between the objects. Hence, I have developed CuCoO with three main objectives a) modelling knowledge about cultural contact, b) modelling cultural contact itself and c) test the methodology explained in the previous chapters.

The CuCoO ontology for cultural contact was developed in the Web Ontology Language (OWL), a recommendation of the World Wide Web Consortium for the formal modelling of domains.[136] OWL features a compatibility layer that allows ontologies to be exported to, and used alongside, the Resource Description Framework (RDF), and allows the representation of complex relationships between entities. The ontology was designed using Protégé, a free and open-source ontology editor that provides an easy-to-use interface for constructing domain ontologies.

136 https://www.w3.org/TR/owl2-overview/ (Last accessed August 2020).

Ontological modelling is a discipline that requires the development of specialised terminology. Such terminology is however 'not used as a means of agreement between experts than as an intellectual tool for hypothesis building based in discriminating phenomena' (Doerr 2009, 1). This emphasises the necessity for certain boundaries in the development of any ontology, especially to define the set of concepts that will be part of the ontological modelling. The problems related to the creation of a standard terminology for the phenomena involved in processes of cultural interaction were explained in Chapter 2, so it will not be discussed in depth here. Nevertheless, broader problems of defining concepts such as culture, ethnicity or ethnic group emerge especially in the semantics of archaeological cataloguing or museum databases where the labels of the artefacts need to reproduce very constrained statements and cannot reflect extensive discussions upon the origin of certain pieces. This means that, in many cases, those pieces that display different ethnic backgrounds or influences remain still partially uncatalogued or belong to a mixed category characterised by more general classifications.

An example of this is the recently released semantic version of the British Museum (BM) catalogue. Performing a quick search in the museum collection database for the town of 'Olontigi' (Aznalcázar, Seville) the user can obtain the record CGR252544[137] a coin which presumably was coined in the town and features the Latin legend 'LONT' and the images of a man looking right and a horse. Within the BM record of the coin, the only label that provides some useful information about the ethnic group who minted it is 'Production Period' which refers to 'Ibero-Roman' as a hybrid entity that merges cultural associations and time frame. The same problem emerges with the Museo Arqueológico Nacional of Spain (MAN). Here, a search for 'Olontigi' submitted to the CERES search

[137]https://public.researchspace.org/resource/?uri=http://collection.britishmuseum.org/id/object/CGR252544 (accessed August 2020).

application[138] provides several records of coins, none of them related to or identified with any cultural or ethnic group. This is both a cataloguing issue and a technical issue. First, it is a cataloguing issue because there seems to be a reluctance to include cultural references to the ethnic groups responsible for the production of certain objects. This could be justified since in some cases the ethnical identification of an object is related to careful scholarship and should not be taken as a cataloguing statement. Nevertheless, in most of the cases, the pieces seem to be related to one or more ethnical groups through further references such as the dating of the pieces 'e.g., Ibero-Roman period' or the geographical area. This sort of information should be presented more clearly and individualised from the rest if possible. This issue is at the same time connected to the technical issue since this reluctance could be related to a lack of the necessary tools to represent cultural relationships between the objects and one, or in some cases more than one, ethnical groups. This reflection is important because the aim of the CuCoO ontology is not to make up for an absence of information about the objects (as no amount of ontology design could compensate an absence of information in the archaeological record) but to provide the necessary tools to integrate this information in the background data of the pieces.

A more recent and accurate attempt was carried out by the Instituto Andaluz del Patrimonio Histórico (IAPH). The database of the IAPH was already reaccessed in section 5.3.2.2. as one of the best examples of Spanish repositories which comply with LOD recommendations. IAPH provides stable URIs that allow the download of machine-readable open access data in JSON-LD. The following table shows a small section of the data snippet provided in section 5.3.2.2. for the Ibero-Roman town of Olontigi. In chapter

[138] http://ceres.mcu.es/pages/Main (Last accessed August 2020).

5 the aim was to provide a more general look into the data to assess the compliance of the resource with LOD recommendations. Since we are looking at how cultural data is modelled in archaeological evidence, it makes sense now to have a closer look into the IAPH data and see what properties have been used to refer to cultural-related concepts which are also contemplated in CuCoO.

JSON-LD data for Olontigi in IAPH:


```
{
        "crono_fin": null,
        "den_tipologia": {
          "@id": "iaph:e-Asentamientos",
          "rdfs:label": "Asentamientos",
          "prov:wasAssociatedWith": [
            {
              "@id":
"http://es.dbpedia.org/resource/Asentamiento"
            },
            {
              "@id": ""
            }
          ],
          "@type": "iaph:Objetos_inmuebles"
        },
        "den_etnia": {
          "@id": "iaph:e-Iberos",
          "rdfs:label": "Iberos",
          "prov:wasAssociatedWith": [
            {
              "@id": "http://es.dbpedia.org/resource/Iberos"
            },
            {
              "@id": "http://datos.bne.es/resource/XX4576478"
            }
          ],
          "@type": "iaph:Etnias"
        },
        "denom_acti": null,
        "crono_ini": null,
        "periodos_cod": "9.2659.9982.10406.2689.2704",
        "crono_ini_cod": null,
        "den_etnia_cod": "2.4701.4931",
        "crono_fin_cod": null,
        "periodos": {
```

```
            "@id": "iaph:e-Edad_del_Hierro_II",
            "rdfs:label": "Edad del Hierro II",
            "prov:wasAssociatedWith": [
              {
                "@id":
"http://es.dbpedia.org/resource/Cultura_de_La_Tène"
              },
              {
                "@id": ""
              }
            ],
            "@type": "iaph:Periodos_historicos"
```

As the data snippet shows, IAPH models ethnic-related features by connecting ethnic groups (e.g., iberos) with settlements and time periods. In the snippet we can see how the data property `("den_etnia":)` is associated to the data value `("iaph:e-Iberos")`, which is also associated to the DBpedia resource (`{"@id":"http://es.dbpedia.org/resource/Iberos"}).` This is an example of the data model adopted by IAPH to connect the settlement ontology to an ethnic group, in this case, Iberians. In the same way, the data displays the property `("periodos":)` associated to the data value `(":{"@id":"iaph:e-Edad_del_Hierro_II"}).` Again, this is an example of the data model adopted by IAPH to connect the settlement of ontology and the ethnic group 'Iberos' to a typified time period. The model suggested by IAPH constituted one of the first attempts made by an institutional data repository to specify a connection between a settlement and an ethnic group in the data modelling process. It is important to acknowledge, however, that IAPH provides information about archaeological sites and not specific objects. Therefore, the ethnic group is associated with a settlement and not a particular material entity. It seems that the idea of identifying certain ethnic identities in archaeological evidence is slightly more controversial than the idea of connecting an ethnical group to a settlement. In this regard, an important point is made by Malkin: that the relation between material evidence and ethnicity does not only involve identifying discrete ethnic groups with specific objects, but also discussing the relations between those groups (2014, 286). Whilst true, the objects themselves should be seen as the instruments that demonstrates such relationships.

Recent scholarship on ethnic and cultural identity seems to agree in that cultural identity should be defined as the self-conscious identification of a person or a group with a constructed group identity that intersect with others in the identification of and interaction between groups (see Mullen 2013; Malkin 2014; Luce 2014; Müller 2014). Therefore 'ethnicity' and 'ethnic identity' may be considered as one of the elements that constitute the 'cultural identity' of an individual together with other constructs such as gender, status or physical appearance.

This research acknowledges the complexities that the modelling of dynamic cultural phenomena as structured categorisations can encompass. However, CuCoO has not been designed as the ultimate set of definitions for the domain of cultural contact in all periods nor all disciplines of knowledge. Instead, CuCoO provides a feasible set of definitions to represent cultural interactions in the archaeological evidence collected in the ERUB dataset, as well as to model such interactions in the form of LOD. The main mechanism to identify cultural contact in CuCoO is based on two main classes and one property. First, the class `cucoo:CulturalTrait` identifies the presence of a cultural feature in an object, e.g., provenance, carving, style, iconography, material, text etc. Through the property `cucoo:isAssociatedWith`, these cultural traits can be then linked to the class `cucoo:CulturalIdentity` which specifies the different cultural identities modelled in the data. When any of the objects modelled presents cultural traits that have been connected with two or more different cultural identities, as for example a sculpture that represents Punic iconography together with an inscription written in Latin, the object is identified as an example of cultural contact. The use of a chain of classes and properties to model and identify cultural traits in the data brings dynamism into the semantic modelling and makes it easier to edit the relationships between objects and ethnic identities if needed. The way in which cultural contact is modelled and identified by the ontology is the main contribution of CuCoO and therefore the primary distinction between CuCoO and other data models. In section 7.5. I shall explain further the rationale and literature behind the definition of each of the classes and properties that configure the ontology.

In summary, CuCoO provides the tools to identify potential cultural traits in the evidence which can be interpreted and related to other items and ethnic groups to identify cultural contact. This inevitably speaks to the limitations of using CuCoO in other contexts since the CuCoO ontology is quite limited in itself as its properties and classes are fairly ad hoc in nature and therefore closely connected to the particular dataset generated. Nevertheless, the development and testing of the ontology is sufficient for critically evaluating the methodology since CuCoO allows the researcher to model and retrieve information on specific cultural constructs as found in archaeological artefacts collected in the ERUB dataset.

7.3. Scope and accessibility

As explained in previous chapters, there is no such thing as a perfect ontology. Most of the time, knowledge of a specific domain is influenced by the domain itself. The definition of cultural contact in modern sociology, for example, is deeply influenced by media, technologies and globalisation, whereas for archaeology it should be oriented towards the exchange of cultural traits and the identification of these in material culture.

There are four different domains represented in the ERUB dataset: (i) the numismatic domain (coinage data); (ii) the archaeological and art-historical domain (sculptural data); (iii) the epigraphic domain (epigraphic data); and (iv) the geographical domain (geo-data). There are already-existing ontologies that provide tools to model information within these domains individually, these can be seen in Fig.3. CuCoO has been built to further explore how cultural contact can be modelled in the objects themselves.

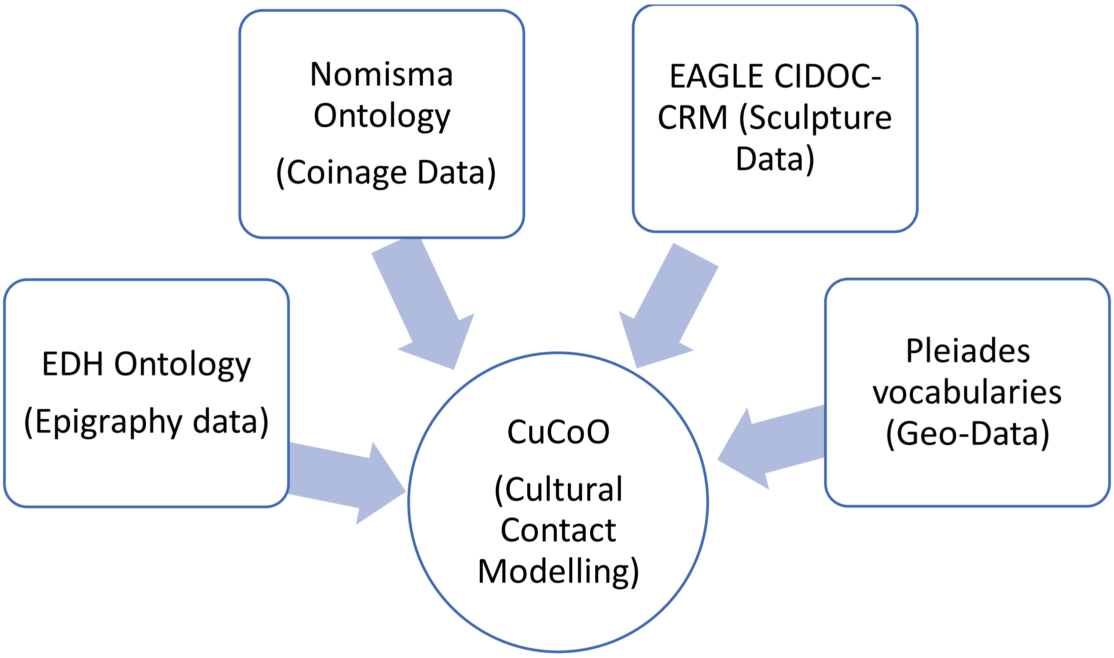

Fig. 7.3. Data models upon which CuCoO has been built.

In the discipline of ontological modelling, there is not always the need to develop a completely new ontology from scratch; in some cases, it is possible to build an extension of a specific section within an already-existing ontology. A good example for this is the CIDOC-CRM project that already incorporates several extensions for the Functional Requirements for Bibliographic Records (FRBR)[139] or the *CASPAR* project[140] (*Cultural, Artistic and Scientific knowledge for Preservation, Access and Retrieval*). Extensions

139 http://www.cidoc-crm.org/sites/default/files/FRBRoo_V3.0.pdf
140 http://www.dcc.ac.uk/resources/briefing-papers/technology-watch-papers/caspar

depend completely on the ontology to extend. Although CuCoO reuses some of the concepts developed by the ontologies mentioned above, it is not an extension of any of these in the proper sense. Instead, CuCoO reuses already-existing concepts when possible and only creates new ones when necessary. In this sense, the model has been built following a top-down approach based on the following steps:

1. Identify the concept embodied in the background data
2. Identify potential existing models when possible
3. Generate the new concept in CuCoO
4. Generate the RDF data following the new model
5. Align with existing ontologies when possible

CuCoO is available through an open-access GitHub code repository[141]. The repository contains the latest RDF/XML version of the ontology, together with the license declaration and a README file with documentation. The README also includes a link to the specification of the ontology rendered by the Live OWL Documentation Environment (LODE)[142]. LODE is a free and open-source redistributable online service that provides human-readable descriptions of OWL ontologies in HTML with embedded links for browsing and navigating (Peroni 2012).

As Peroni, Shotton and Vitali (2012) discuss, any attempt to guarantee the wider adoption of Semantic Web technologies implies the development of tools that allow easy access by non-expert users to Semantic Publishing. HTML documentation for ontologies is an important part of the necessity to help the user to understand the extent and complexities

[141] The repository can be accessed at https://github.com/paulagranados/CuCoO (accessed August 2020).
[142] http://www.essepuntato.it/lode (accessed August 2020).

of the ontology development and coverage. It is fundamental to document not just the final version of the process but the whole development and design procedure. The development of CuCoO has gone through different steps until achieving the target schema increasing the number of classes and properties when required by the data integration process itself. Each of the previous attempts has been saved for further documentation of the development process. The user just needs to reach the LODE service at (https://essepuntato.it/lode/) and input the URL of the ontology to call the service (https://raw.githubusercontent.com/paulagranados/CuCoO/master/CuCoO.owl.ttl)

This allows the automatic update of the specification of the ontology when the ontology file is updated in the main URL; in this case, the GitHub repository for CuCoO.

The graphical display of the ontology constitutes another important part of the ontology visualisation. The graph of the ontology[143] is provided through the WebVOWL service[144] (Fig. 7.4) The Visual Notation for OWL Ontologies (VOWL) provides force-directed graph layouts for ontologies in the OWL language. Classes are depicted as circles connected by arrows that represent the property connections. Property labels and data types are represented as rectangles and information about individuals can also be displayed. VOWL works in a similar way to LODE in that it loads the ontology data directly from the URL provided so that the updating process is also automatic. VOWL also includes statistical information about the ontology given. Apart from the ontology documentation and the graphical display online, a graphical representation of CuCoO is also provided in this section to ensure user accessibility. Nevertheless, this diagram only

143 The link to the visualisatin is also provided in the README file of the ontology Git Hub repository.

144 http://vowl.visualdataweb.org/ (accessed August 2020).

provides the most basic connections between classes and properties without the possibility to access class definitions or inferred connections.

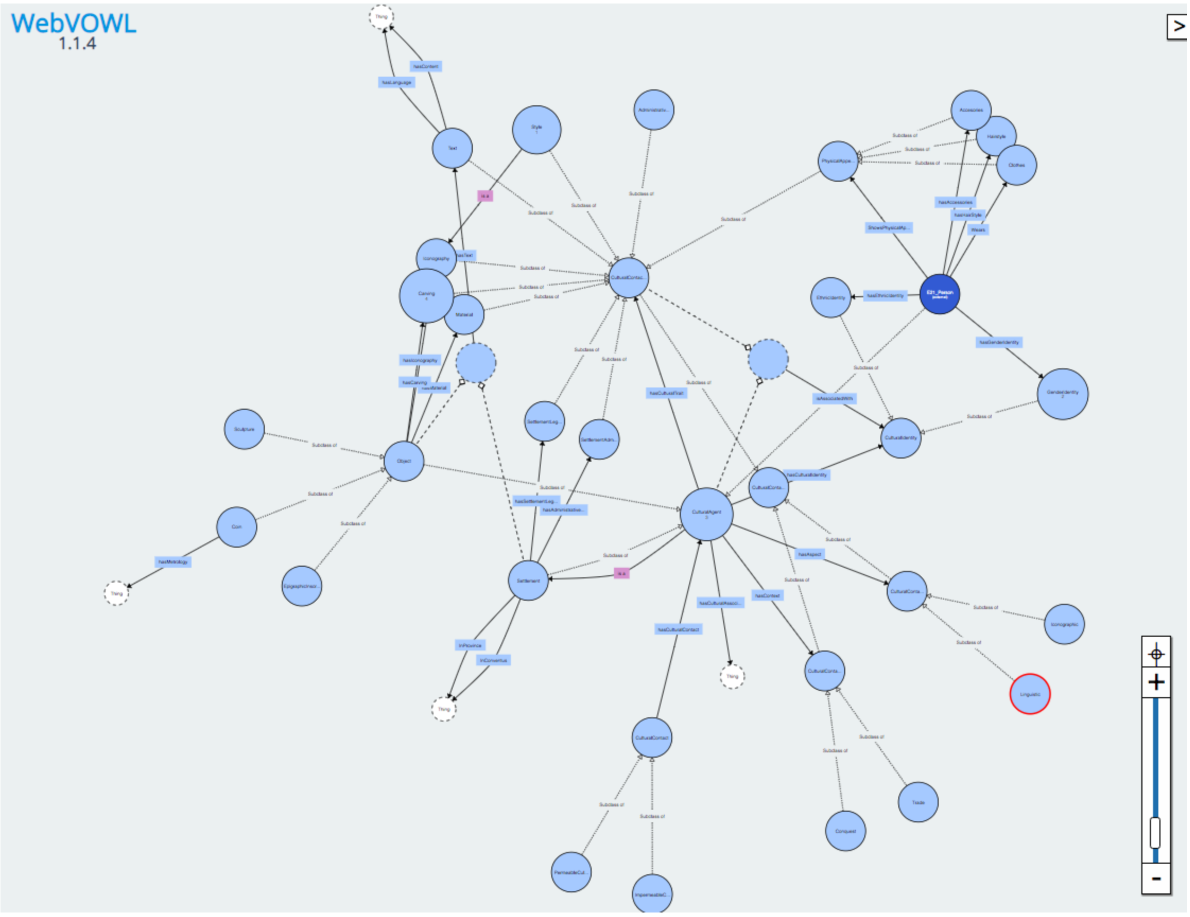

Fig. 7.4. Graphical display of the ontology through the WebVOWL service.

7.4. The methodological question.

In the last decade, the peak of interest has been the development of methodological approaches that support ontology design. METHontology (1), OnTo-Knowledge (2), DILIGENT (3) and NeOn (4) are some of the latest examples of ontology building (Gómez Perez/Suárez Figueroa, 2009). These methodologies provide guidelines for developers to build ontologies by focusing on different activities as part of the skeleton of the production process.

The Cultural Contact Ontology (CuCoO) has emerged as a consequence of the dissatisfaction with culture-related conceptual models, and, more specifically, cultural-contact-related conceptual models in antiquity. The CuCoO ontology has been configured to fill this gap and to explore the possibilities of cultural contact dynamics in ontological modelling. Nevertheless, it has not been developed as a standalone formal model for semantically describing processes of cultural interaction, but as a resource to effectively develop data integration and data modelling from several heterogenous data sources. The effectiveness of this is intimately related to the user experience and evaluation of the quality and trustworthiness of the data model. Therefore, the following evaluation of the strengths and weakness of the abovementioned ontology development methodologies looks especially at the user experience and testing guidelines as well as instructions for the identification and reutilisation of already-existing knowledge resources.

The first method to discuss is METHONTOLOGY, which was developed by the Ontological Engineering Group of the Universidad Politécnica de Madrid (Corcho et al. 2005). This focuses on the construction of ontologies at the knowledge level as demonstrated by the practices of: 1) specification of the reasons behind the construction of the ontology, its use and final users; 2) conceptualisation of the domain-related perceptions to convert them into semi-formal specifications; 3) formalisation that turns the conceptual model into a formal model; 4) implementation procedure that produces computable models in any of the ontological languages available. METHONTOLOGY provides a system to identify the ontology building process, life cycle of the schema and the techniques developed in terms of management systems and support activities; it does not, however, provide guidelines on version management, nor on possible amendments after user evaluation.

The second methodology is the On-To-Knowledge methodology (OTKM), which is specially oriented towards ontologies for knowledge management applications and was designed and applied for the On-To-Knowledge project. The work procedure proposed by On-To-Knowledge is focused on (Sure/Staab/Studer, 2004):

1) a feasibility study to evaluate economical, technical and pragmatical viability of the project;
2) a kick-off phase to produce a semi-formal specification of the final ontology;
3) a refinement step to formalise the embryonic description of the ontology into a target schema;
4) the evaluation of the ontology from the point of view of the user, the technology and the ontology itself;
5) the application and evolution of the final result.

OTKM proposes the generation of new versions after the user evaluation of its application without, however, providing any guidelines on how to do this. Regarding the reutilisation of already-existing models, OTKM does not provide specific guidelines on how to identify and reuse such models.

The third methodology is the DIstributed, Loosely-controlled and evolvInG Engineering of oNTologies (DILIGENT), which recommends five main activities for the ontology development process (Vrandečić et al. 2005):

1) a building process that does not require the completeness of the initial shared ontology
2) local adaptation of the ontology to the individual user needs
3) analysis of local ontologies and the requests for changes
4) revision of the shared ontology to realign the final product to user needs
5) local update by the users of their own local ontologies

DILIGENT is focused on collaborative ontology engineering procedures and is one of the first to focus directly on the user experience, providing guidelines for user testing and for the application of user-suggested changes; like OTKM, however, it does not provide guidelines for the identification and re-utilisation of already-existing knowledge resources.

Finally, NeOn is a scenario-based methodology that contemplates a technological approach focused on the development of a technological product: it is driven by the existence of ontology networks constituted by geographically distributed groups of domain experts and ontology practitioners that require collaborative environments of ontology engineering. NeOn takes into account the dynamic dimension of the ontologies and the necessity for reuse and re-engineering of already-existing knowledge resources. NeOn is based on a series of principles: completeness, consistency, efficiency, environment, finiteness, flexibility, perspectives, transparency and usability.

After the assessment of the methodologies currently available and a review of the state of play regarding ontology engineering procedures in terms of user experience and reuse of already-existing knowledge modelling products, NeOn and DILIGENT seemed to be the most useful methodologies to apply.

NeOn facilitates the ontology engineering work of collaborating groups with geographically dispersed members and demonstrates flexibility and dynamism in the capability to combine different scenarios. The necessity of a collaborative method may not seem too obvious here as I am a lone researcher, nevertheless collaborative aspects were still important at the time to share my work with my supervisors. Other platforms that allow collaborative work such as GitHub proved significantly useful in terms of code and data integration.

DILIGENT has a user-oriented approach providing guidelines for user-testing protocols during the course of the entire process. Nevertheless, whereas DILIGENT does not provide guidelines for the reutilisation of already-exiting knowledge modelling products, NeOn contemplates this scenario and suggests procedures for reuse and merging of existing ontological resources. CuCoO reuses some sections of existing ontological resources such as the *Nomisma* ontology and CIDOC-CRM. Because of this, a combination of NeOn and DILIGENT methodologies has constituted the approach followed in the development of CuCoO, which can be summarised as:

1. A building process that does not require completeness of the ontology but that has been developed following the workflow of the dataset
2. Adaptation of the ontology to individual user needs, mainly driven by the data modelling requirements
3. Analysis of the ontology and incorporation of changes
4. Revision of the shared ontology to realign the final product to user needs
5. Local update by the users of their own local ontologies.[145]

7.5. Concept hierarchies in CuCoO

Ontologies represent the knowledge of any specific domain by the definition of classes, properties and instances. Classes are the focus of the ontology, since they describe the concepts in the domain (e.g., the class of 'sculpture' represents all sculptures). Classes

[145] 'local update' here refers to possible updates of the ontology by other contributors e.g., supervisors.

can be related to one another in different ways (subclass, superclass, class equivalence or disjointness, or algebraic operations over classes such as intersection, union and complement). Properties tend to connect individuals with classes, but they can also be of different types (object properties and datatype properties).[146] Instances constitute the last element of the ontology: the individual data entities.

Most models start in a core class from which the remaining classes and subclasses emerge. The design requires several steps until the target model is achieved. The process of concept design may vary depending on the objective of the ontology itself. CuCoO has been developed directly from two main necessities. First, data integration: as explained in Chapter 6, the data modelling and integration has shaped the way in which the ontology has been constructed. So, for example, if a new data record 'sculpture' was being created, then the properties needed to model such sculpture were created as well. The steps followed in the procedure for building these concepts are represented in Fig.7.5.

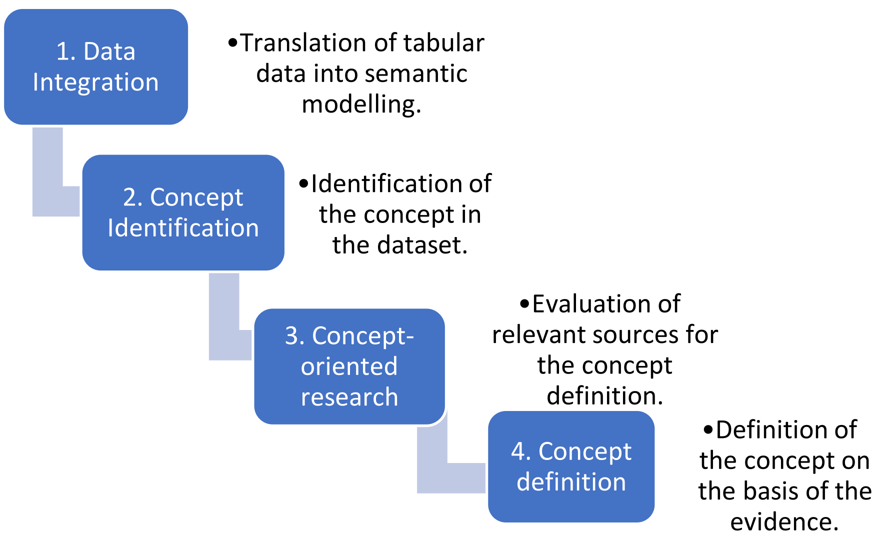

Fig. 7.5. Procedure for the definition of concepts in the CuCoO ontology.

[146] Note that these notions (object properties and datatype properties) are standards in RDFS and OWL.

Nevertheless, the construction of CuCoO has also emerged from a second necessity directly related to the approach taken towards cultural contact (explained in Chapters 2 and 3), the research questions (Chapter 1) and the queries that will be run on the data (Chapters 8 and 9).

The main objective of the CuCoO ontology is to identify cultural contact. In this regard, the definitions of cultural contact and ethnicity given in Chapter 2 are fundamental to understand the core schema of the ontology. The class `cucoo:CulturalContact` is defined as the phenomenon of interaction between at least two communities with different cultural and ethnic backgrounds. The cultural background of a community is directly related to the cultural identity of the community and its members. `cucoo:CulturalIdentity` is a class that includes the different elements that constitute the cultural identity of a person or group, including gender identity, social identity or ethnic identity. 'Ethnic Identity' borrows Mullen's (2013, 5) definition and refers to the 'self-conscious identification of a group with a series of cultural traits, plus notions of shared history, shared territory, kinship and common descent which differentiate it from other groups'.

CuCoO is configured to identify cultural contact from the presence of traits of different cultural backgrounds in one and the same object. I have defined `cucoo:CulturalTrait` as 'Characteristics of human action which are acquired and transmitted by any kind of communication in a situation of cultural contact'. Thus, for example, a sculpture can be modelled on the basis of the cultural traits identified on it such as provenance, carving, style, iconography, material and text (where extant). Each of these can be then associated with different cultural identities (e.g., Roman, Iberian, Phoenician etc.). When the sculptural data presents cultural traits identified with different cultural identities (for example, a coin with Punic iconography combined with a Latin legend) then the object is identified by the ontology as an example of cultural contact.

The cultural agent class in CuCoO is also fundamental to understanding the way in which the data modelling works. To understand what the class refers to, we shall now come back to Gell's *Art and Agency* (1998). In his anthropological theory of art, Gell considers it a matter of agency and performance. Gell's theory relies on two main concepts, indexes and agents. Indexes are the objects themselves, material entities that motivate responses in the recipients. The index, says Gell, 'must be seen as the outcome and/or the instrument of social agency'. 'Social agents' are those who exercise social agency, those persons and objects that 'cause events to happen in their vicinity' (Gell 1998, 16). Social agency can be exercised by persons and things. However, agents can only be agents as far as they have 'patients' in respect to them; that is, recipients in relation to whom the objects are considered to generate this agency. Gell did not consider all the objects 'agents', only those that provoke some kind of social reaction in their audience. As mentioned earlier in this chapter, Gosden and Marshall (1990) agree with Gell in considering objects to not just embody but generate meaning around them. All the objects collected in the ERUB dataset have been catalogued, studied and displayed in museums and private collections as symbols of past cultures, considered as agents of cultural meaning that played a role in the lives of the ancient inhabitants of the peninsula. They are both the product and the agents of the cultural interaction that took place in that chronological and geographical context. Because of this, I shall consider them in CuCoO as cultural agents. The following section constitutes a brief description of the classes and properties of CuCoO.

7.5.1. Classes

A class is a group of entities that clusters together different objects with features in common in the representation of a specific domain. CuCoO defines 35 classes which provide a conceptual categorisation for cultural contact features represented in ERUB. The class `owl:Thing` is the core concept in CuCoO and the starting point of this and of any other OWL ontology. It was preferred over other top concepts from alternative ontologies such as for example CIDOC for being part of the OWL specification and the most widely used in ontology building. `owl:Thing` is the concept that sits above all other concepts. 'Thing' is subsumed by four distinct sibling classes: `cucoo:CulturalContactFeature`, `cucoo:CulturalAgent`, `cucoo:CulturalContact` and `cucoo:CulturalIdentity`, (Fig. 7.6).

The class `cucoo:CulturalContact` has two subclasses: `cucoo:ImpermeableCulturalContact` refers to a phenomenon of cultural contact (e.g., a Roman foundation of a Colonia) in which there is no evidence for cultural influence nor cultural change (e.g., no appearance of indigenous influences in the material culture); `cucoo:PermeableCulturalContact` refers to a situation of cultural contact (e.g., the Punic conquest of an Iberian oppidum) where there is evidence for cultural influence (e.g., appearance of Punic iconography in the material culture). The classes `cucoo:PermeableCulturalContact` and `cucoo:ImpermeableCulturalContact` are mutually exclusive; in ontological modelling, this means that they share a disjointess axiom about each other: thus, an individual cannot be an instance of both classes at the same time. If an individual were an instance of these two disjoint classes, it would make the resulting model inconsistent.

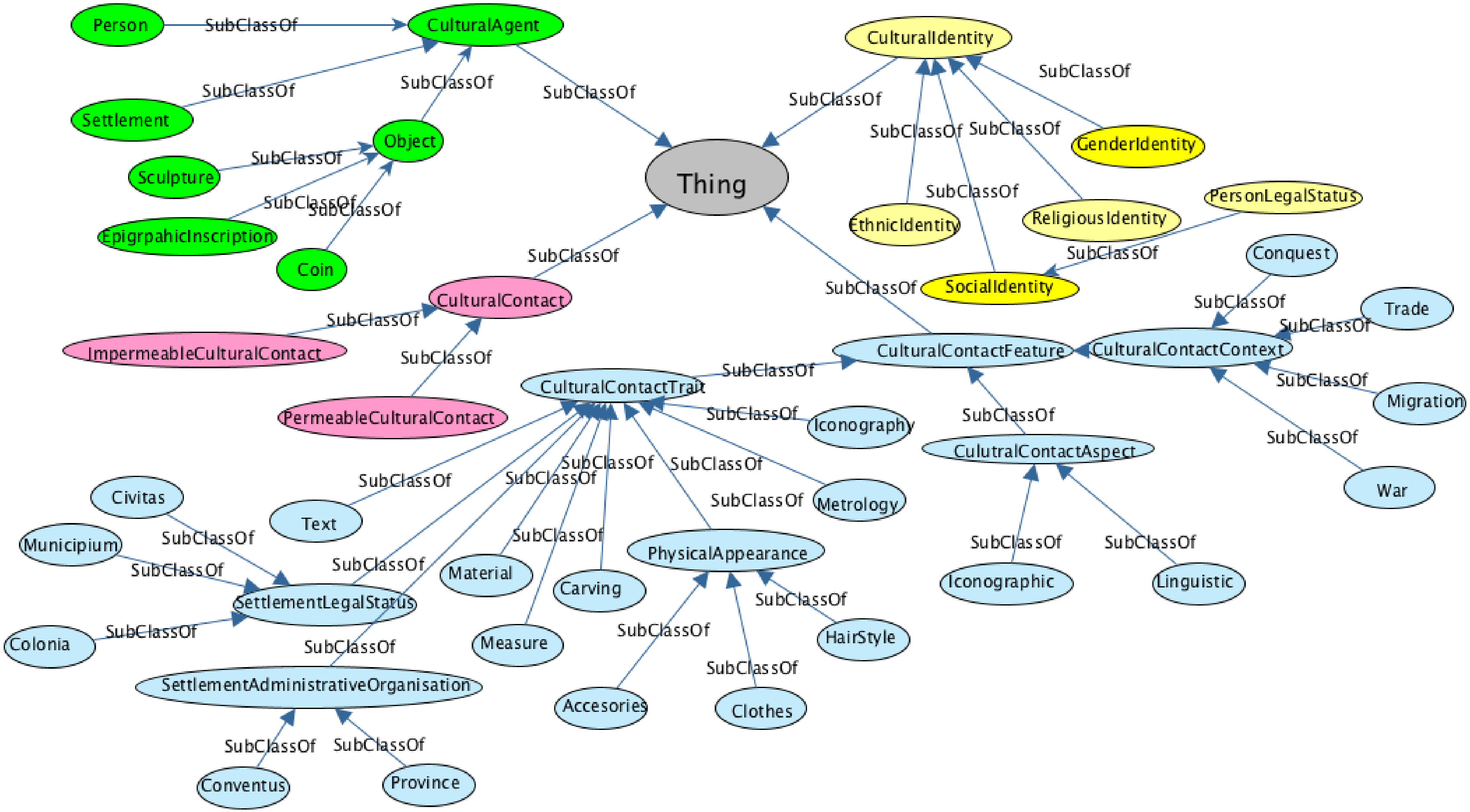

Fig. 7.6. Graphical visualisation of the main classes in CuCoO.

The super-class cucoo:CulturalContactFeature refers to cultural contact features (context, aspect, trait) that can be identified in the entities from ERUB and that have been conceptualised and typified in the ontology for being of interest to this research. These are included in the classes: cucoo:CulturalContactContext, cucoo:CulturalContactAspect, and cucoo:CulturalContactTrait as seen in Fig.6.5. cucoo:CulturalContactContext refers to 'the context in which the situation of cultural contact takes place' (for example in a context of migration): it is subsumed by cucoo:Conquest, cucoo:Trade, cucoo:War and cucoo:Migration. The sort of evidence collected in CuCoO comes mainly from situations of trade in the case of the Phoenician evidence and conquest in the case of the Punic and Roman evidence. cucoo:CulturalContactAspect refers to 'the main feature that defines the cultural contact phenomenon'. This class is only subsumed by cucoo:Linguistic and cucoo:Iconographic, for being these the main types of cultural contact that can be identified in the ERUB dataset and therefore the two sorts of cultural contact that CuCoO aims to explore in the evidence. Finally, cucoo:CulturalContactTrait allows the identification of cultural traits (e.g., material, style) in the objects. It is a super-class that encompasses many different sub-classes, such as text, material, measure, carving, appearance, weight, iconography etc. Within the 'Cultural Trait' class, cucoo:Text is defined as an utterance or a coherent set of statements; therefore, it encompasses any text written in any possible media, from the epigraphic text written on stone to a coin legend written on metal.

7.5.2 Properties

CuCoO has a total of 20 object properties which can be seen in Fig.7.9. In ontological modelling, there are two types of properties: object properties (for which the value is an individual) and datatype properties (for which the value is a data literal). Object properties connect individuals with their class and their use is recommended for consistency and interlinkage in LOD. In CuCoO, there are 5 properties for which the value is a literal: `cucoo:ShowsPhysicalAppearance`, `cucoo:hasAccessories`, `cucoo:hasHairStyle`, `cucoo:Wears` and `cucoo:hasGenderIdentity`. These properties have been generated to model physical appearance and gender identity. The reason why these properties take literals instead of individuals is the lack of existing controlled vocabularies as explained in 6.4. These properties are not established as datatype or object properties in CuCoO but as plain instances of `rdf:Property`. Although OWL-aware parsers typically interpret these as annotation properties, it is possible to specialize them to be of either of the other types through their usage.

Properties may have a domain and a range specified. Object properties connect individuals from the domain to individuals from the range. In CuCoO, for example, the property `cucoo:hasCarving` has sculpture as the domain (the only type of object that can have a type of carving) and carving as the range (if the subject has a carving, then the object is a Carving). In the graphic representation of the ontology the domain is represented by a green arrow that goes from the class to the property (e.g., the green arrow that goes from coin to `cucoo:hasMaterial`). In the same way, the range is represented by the green arrow that connects the object property to the class (e.g., the green arrow that goes from `cucoo:hasMaterial` to the `cucoo:CulturalContactTrait` subclass `cucoo:hasMaterial`) (Fig. 7.7).

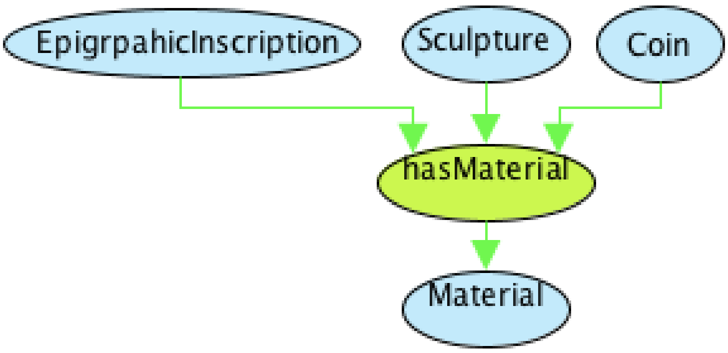

Fig.7.7. Graphical representation of domain and range of `cucoo:hasMaterial`.

The other properties in CuCoO develop a similar function: their ultimate goal is to help define the cultural agent to later identify possible cultural traits that can demonstrate cultural interaction between the groups towards which the object is associated. For the description of individuals, the property `cucoo:showsPhysicalAppearance` relates the class `cucoo:PhysicalAppearance` to the `cucoo:CulturalAgent` 'Person'. `cucoo:PhysicalAppearance` is considered as a class of `cucoo:CulturalTrait`. Therefore, it could denote some kind of cultural interaction if for example a sculpture displays (Person →hasCulturalTrait → PhysicalAppearance → wears → Toga → isAssociatedWith → CulturalIdentity → Roman), whereas it also displays (CulturalTrait→ Carving → SchematicFolds → isAssociatedWith → CulturalIdentity → Indigenous).

In CuCoO, there is currently no need for a difference between real or unreal persons: this would be a possibility for further developments. Therefore, a person depicted in a sculpture or a coin could have the same appearance as a real person itself. The `cucoo:showsPhysicalAppearance` has three sub-properties: `cucoo:hasHairstyle`, `cucoo:hasAccessories` and `cucoo:wears`. These subclasses have been adapted from the Ontology for Gendered Content Representation of

Cultural Heritage Artefacts (Kyvernitou/Bikakis, 2017). In the Ontology for Gendered content, 'Accessory' refers to "all things that complement a person's appearance", 'Hairstyle' to "the way in which an entity's hair is cut and arranged" and 'Dress' to "the clothing that entities wear" (Kyvernitou and Bikakis 2017, p.7). If we look at the 'ancestors' of this graph (Fig. 7.8.), we can see how material is a subclass of the class `cucoo:CultualContactTrait`, which is related by the object property `cucoo:isAssociatedWith` to `cucoo:CulturalIdentity`.

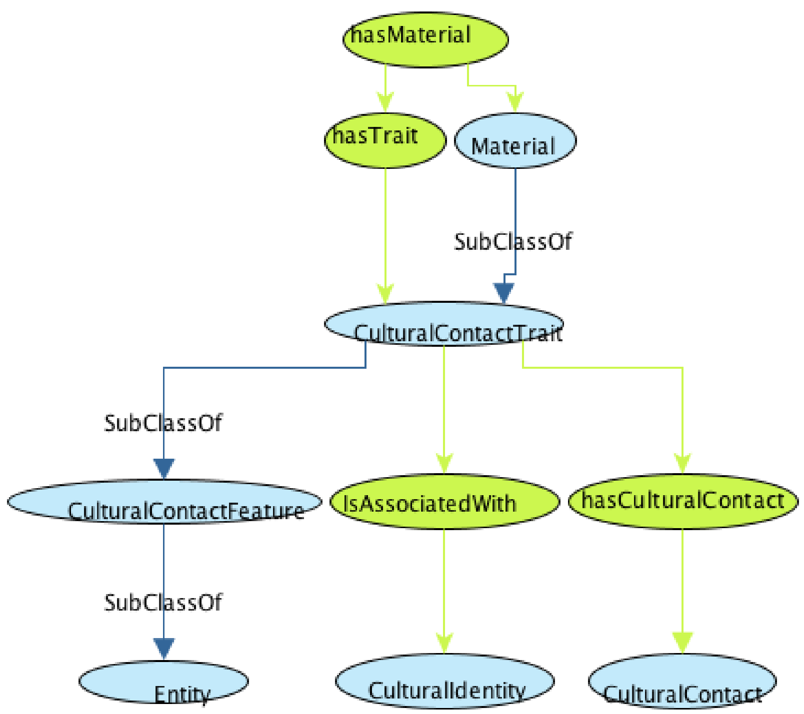

Fig. 7.8. Graphical representation of ancestors of `cucoo:hasMaterial`.

The object property `cucoo:isAssociatedWith` relates a cultural contact trait (e.g., a type of material) with the cultural identity it is associated with, without restrictions. For example, a Latin inscription in a sculpture can be associated with Roman cultural identity because it is written in Latin, in the same way that it could be related to Iberian cultural identity if it were to record an Iberian name in Latin script. This property also relates a settlement with the cultural identities that have been attested in the territory by archaeological research. Nevertheless, these two examples record different levels of assumptions. In the second case, the assumptions were made in the dataset and translated into RDF using CuCoO properties. So, for example, the online Google spreadsheet for settlement data records the cultural identities attested in the settlement by archaeological research and these have been translated into the RDF graphs (e.g., Cádiz `cucoo:isAssociatedWith` 'Phoenician'). However, the same property also relates a cultural trait with the cultural identity it could be associated with (Fig.7.9) These associations are not specified in the data but are made by ontology reasoning. In the following section I shall explain how ontological reasoning works.

The following diagram (7.9) shows all the classes and properties in CucoO and the relationships among them.

.

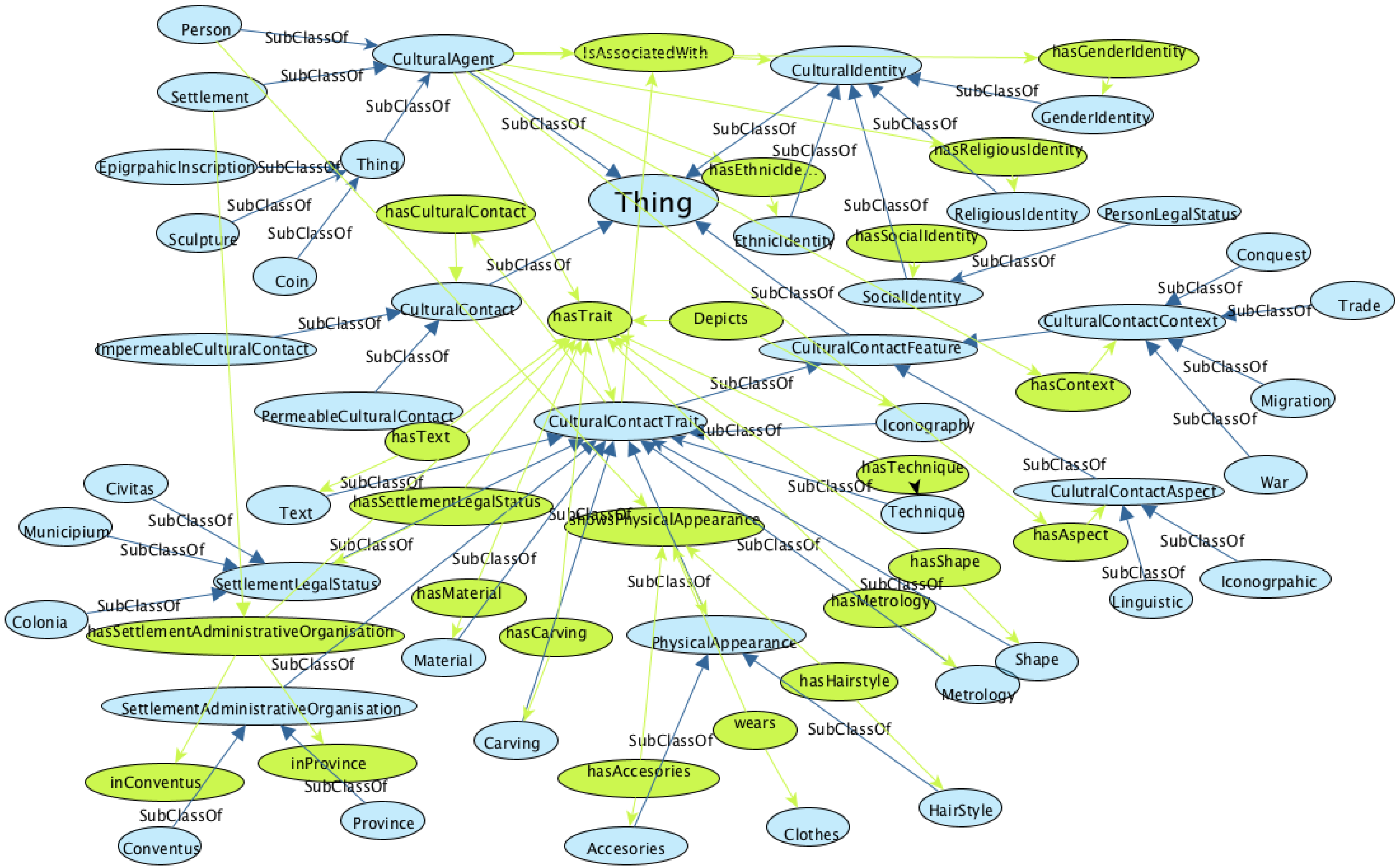

Fig. 7.9. CuCoO classes (blue) and properties (green).

7.6. Inference rules

Ontologies can be used to carry out complex reasoning. Reasoning means the deriving of facts that are not explicitly expressed in the ontology or in the knowledge base. There are two types of reasoning: ontology-based and rule-based. Ontology-based reasoning is the most common type of inference developed by the use of ontologies (e.g., RDFS or OWL reasoning). It provides inferences based on the classification established in the ontology. The inference rules for RDFs or OWL are fixed by the languages themselves.

As explained above, CuCoO has been written in the OWL language. This means that the ontology already incorporates the basic ontology-based form of reasoning. The basis for ontological reasoning is Description Logics defined by class and property characteristics (Baader et al. 2003). These are applied by the reasoner to infer new knowledge about instances and their relations. Some of OWL's more common class characteristics are `rdfs:SubClassOf` or `owl:DisjointWith`. Earlier in this chapter, it was explained how the characteristic `owl:DisjointWith` allowed us to establish that the subclasses of Cultural Contact, `cucoo:PermeableCulturalContact` and `cucoo:ImpermeableCulturalContact` share a disjoint axiom about each other, meaning that the entities could not be an instance of both classes at the same time.

Every time an instance is modelled in the ontology within one of the two classes, the ontology automatically states that it shares the disjoint axiom with the instances in the opposite class. Some of the most common property characteristics in OWL are `owl:inverseOf`, `owl:SymmetricProperty`, or `owl:TransitiveProperty`. `owl:TransitiveProperty`, applied for example to `rdfs:subclassOf`, establishes that if class A is a sub-class of B, and B is a sub-class of C, then A is a sub-class of C.

Therefore, in CuCoO, if a class like `cucoo:Material` is a `rdfs:subClassOf` `cucoo:CulturalTrait` and `cucoo:CultturalContactTrait` is a subclass of `cucoo:CulturalContactFeature`, then `cucoo:Material` is also a `cucoo:CulturalContactFeature`. Thus, every time we model an instance such as copper or marble as a material in CuCoO, it will also be considered as a `cucoo:CulturalTrait` and a `cucoo:CulturalContactFeature`.

This kind of reasoning allows the development of complex queries. A query is basically a question that the user runs over the dataset to ask for some pieces of information that comply with certain specific conditions. In this way, we could ask the ERUB dataset to provide all the objects that are made of marble. The problem comes when we ask ERUB to provide all the objects that are associated with a certain cultural identity, for example Roman. This relation is not materialised as a statement in the data themselves, because it is a subjective assumption that can vary from one context to other. The way to do this is the so-called rule-based reasoning.

Rule-based reasoning is the second type of reasoning that ontologies can support. It is grounded on semantic rules which can be written on top of the ontology itself to trigger further inferences that are not specified or cannot be derived from the core model. The inference based on rules requires two things: a) a language for representing the rules and b) a rule engine. There are several options for both engines and languages. Among them, one should acknowledge especially the Semantic Web Rule Language (SWRL) and the SPARQL Inference Notation (SPIN), a SPARQL-based rule and constrain language for the SW.[147] I have decided to write CuCoO reasoning rules in SPARQL because: a) it places the computational burden of calculating inferences upon the triple store itself, but at an acceptable cost per rule, and b) all triple stores can run rules written this way, whereas there is no guarantee for SPIN or others. Because of this, it made sense to write the rules as SPARQL construct queries which will later be run in Fuseki, the triple store that is being used to host and query the ERUB dataset.

SPARQL rules are here represented as SPARQL construct queries that apply to all instances that match the graph patterns in the ‘WHERE’ clause. CuCoO reasoning rules establish the connections to be made by the reasoner between the type of cultural contact trait and the cultural identity that it can be associated with. These inference rules were built upon domain instances generated for the ERUB dataset. Therefore, they are not within the CuCoO ontology itself, but should be considered as an implementation of it. They can only be applied to ERUB or similar datasets, because the assumptions on which they depend were developed within the framework of the cultural setting of early Roman Ulterior Baetica. In addition, these rules are by no means complete or definitive. Even in the ERUB dataset, there might be instances in which the rules do not map into reality; therefore, each case should be seen individually and explored independently from the rest. There is no rule regarding cultural identity that can be applied in an absolute manner to material culture: they are only instruments that allow the exploration of cultural exchange in the data.

[147] For further reference: https://www.w3.org/Submission/SWRL/ https://www.w3.org/Submission/spin-overview/

The process followed to write the rules consisted of, first, the identification of the different types of cultural traits that can be typified in the ERUB dataset. For example, the class `cucoo:CulturalTrait` ‘Clothes’, has different types in ERUB (e.g., toga, tunic, chiton etc.). The second step requires a deeper insight into the data, as well as secondary scholarship, to elucidate whether these features have been associated to any specific cultural identity in the past.

The identification of clothing habits is one of the most prolific themes in studies of ancient sculpture in Ulterior-Baetica. Several works reflect upon the different garments represented in stone and put them in relation with the different communities on the peninsula. Traditionally, the depiction of individuals in a toga has been associated with Roman cultural identity. There is plenty of literature on the identification of individuals wearing a toga or Roman military clothing with Roman groups on the peninsula, whereas other types of garments or objects such as the *falcata* (the traditional Iberian sword) are associated with Iberian groups (e.g., Chapa Brunet 2012).

The literature produced concerning Monuments A and B of Osuna (Seville), two sculpture groups that attracted a great deal of interest in Roman studies since their discovery in 1903, tends to separate the pieces into two different sets: Monument A ‘the Iberian set’ and Monument B ‘the Roman set’, based on the iconography of the pieces, style, material and the carving style. Jiménez and Roda (2015, 490) consider the representation of the clothing and armoury to reveal the presence of archaistic prototypes more associated with indigenous communities. León Alonso (1981), for instance, considered the naturalism of the pieces as well as the schematic monotony in the way the clothing was depicted in Monument A as reasons to associate it with Iberian cultural identity. These features, together with the representation of rituals normally carried out at funerals of important people in Iberian society, support their observations.

These sorts of associations between clothing and cultural identity can be written in the form of rules so that SPARQL can infer by itself this kind of reasoning. It is important to note, however, that associating a specific cultural trait to a certain cultural identity does not mean that the object was used in any specific way, just that it reflects a cultural trait. Hence, one of the rules could say that all the objects that display a Toga can be associated with Roman cultural identity. The third step implies the actual writing of the rules. The rules were written first in Natural Language (NL) to then be translated into SPARQL. The following chapter includes a brief introduction to SPARQL and a query example (see section 8.2.)

Example Rule 1: If the person represented in the object wears a specific garment, then such a garment is considered a cultural trait and the object is associated with the cultural identity specified.

Construct Query 1: Clothing

```
# definition of prefixes
PREFIX cucoo:
<http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>
PREFIX epi: <http://edh-www.adw.uni-heidelberg.de/edh/ontology#>

# construct clause with the triples to generate
CONSTRUCT {
  ?x cucoo:hasCulturalAssociation ?assoc .
  ?assoc a cucoo:CulturalAssociation
       ; cucoo:isAssociatedWith ?uident
       ; cucoo:hasCulturalContactTrait
<http://data.open.ac.uk/erub/culturalTrait/clothing>
       ; cucoo:value ?clothes
}
WHERE {
```

```
  ?x epi:hasPerson ?person .
  ?person cucoo:wears ?clothes .

  # A table that associates cultural identity labels to clothing
  VALUES (?clothes ?ident) {
    ( "chiton"@en                    "Iberian")
    ( "cross_strips"@en              "Iberian")
    ( "Tunic"@en                     "Roman"   )
    ( "Toga"@en                      "Roman"   )
    ( "Tunic_and_weapons"@en         "Roman"   )
    ( "Tunic_palla"@en               "Roman"   )
    ( "bulla_and_Toga_praetexta"@en "Roman"   )
   }

  # functions to automatically construct a new URI for the
  # association based on the URI of the object
  BIND (URI(CONCAT(STR(?x),"/assoc/", LCASE(?ident) ,"/clothing"))
AS ?assoc)
  BIND (URI(CONCAT("http://data.open.ac.uk/erub/cultural_identity/",
LCASE(?ident) )) AS ?uident)
}
```

The query example provided above first establishes the ontology we are using as the core model under the prefix <cucoo> and other ontologies that were used in the modelling of the data: in this case, the <epi> ontology to model the people appearing in the sculptures. Then, it runs a CONSTRUCT query that generates new RDF triples: these relate the sculpture ?x with a cultural association ?assoc. This association is an intermediate step between the sculpture and the final cultural relation. The query specifies that such an association (?assoc) is a Cucoo:CulturalAssociation that will be associated using cucoo:isAssociatedWith with a cultural identity whose value is specified in the values table: that association is based on an instance of cucoo:CulturalContactTrait, in this case (http://data.open.ac.uk/erub/culturalTrait/clothing). The 'CONSTRUCT' clause is followed by the 'WHERE' clause. Here the query specifies in which cases the 'CONSTRUCT' clause should be applied, that is, those sculptures (?x) that comply with `epi:hasPerson (?person)`, so that such `(?person)` `cucoo:wears (?clothes)`. This is then followed by a table of values that associates each known type of clothing from ERUB to a specific cultural identity. Finally, the BIND form allows a value to be assigned to a variable from a basic graph pattern or property path expression, effectively allowing the definition of functions inside a query. In this case, the functions construct a specific URI for the variable `(?assoc)` with the values `(?clothes)` and `(?uident)` of each association. An example of the reasoning followed in this rule is visualised in Fig. 7.10.

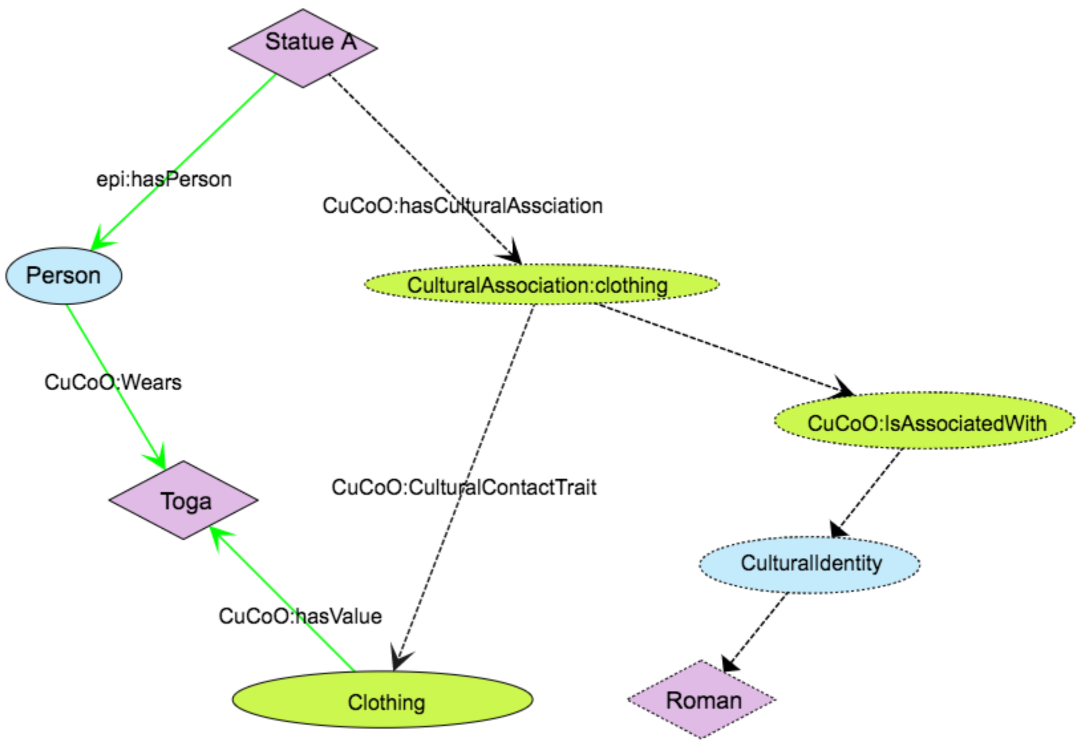

Fig. 7. 10. Modelling of statues depicting people wearing a toga, where dashed lines depict the inferred entities and connections produced by the query.

Example Rule 2: If the object has a text and the text is written in a specific language, then the object is associated with a specific cultural identity.

Construct Query 2: Text

```
# definition of prefixes
PREFIX bmlang:
<http://collection.britishmuseum.org/id/thesauri/language/>
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX cucoo:
<http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>
PREFIX epi: <http://edh-www.adw.uni-heidelberg.de/edh/ontology#>

# construct clause with the triples to generate
CONSTRUCT {
   ?x cucoo:hasCulturalAssociation ?assoc .
  ?assoc a cucoo:CulturalAssociation
       ; cucoo:isAssociatedWith ?uident
       ; cucoo:hasCulturalContactTrait
<http://data.open.ac.uk/erub/culturalTrait/inscription>
       ; cucoo:value ?language
}
WHERE {
  ?x epi:hasInscription ?inscription .
  ?inscription crm:P72_has_language ?language .


  # A table that associates cultural identity labels to language
  VALUES (?language ?ident) {
  (bmlang:Latin                  "Roman"   )

  (bmlang:Latin?                 "Roman"   )

  (bmlang:hieroglyphic           "Egyptian"   )

  (bmlang:indigenous             "indigenous"   )

}

  # functions to automatically construct a new URI for the
  # association based on the URI of the object

   BIND (URI(CONCAT(STR(?x),"/assoc/", LCASE(?ident) ,"/language"))
AS ?assoc)
  BIND (URI(CONCAT("http://data.open.ac.uk/erub/cultural_identity/",
LCASE(?ident) )) AS ?uident)
}
```

The query above follows a similar pattern to that used in the previous query to link every object with a text to a cultural association, and then relate that cultural association with a specific cultural identity.

Following this pattern, seven CONSTRUCT rules have been executed for the fields of clothing, accessories, hairstyle, carving, material, iconography and text. In this way, the request for the data about a specific object such as the already mentioned votive offering from Ituci Virtus Iulia (Torreparedones, Baena, Córdoba: Fig. 6.4.) provides the different cultural traits that can be perceived and are collected in ERUB.

As seen before in the data provided for object dj030941 (Table 7.1.), the piece was been identified by the museum catalogue as a votive offering made in limestone that depicts a woman's head. It was dated between 200 and 100 BCE and it is currently hosted by the Museo Arqueológico y Etnológico de Córdoba. The core data shows that according to the museum catalogue, the object belongs to an Ibero-Roman cultural context. This information is directly justified in the data by the property (`cucoo:museumCulturalContext`). The associations made by the museum are reasoned in the catalogue, but they are not directly specified in the data, so the user cannot distinguish why the object is Iberian or Roman just by looking at the data. In contrast, the cultural associations created within ERUB have been made using SPARQL rules based on the attributes of the piece. The following table (7.2.) displays the inferences obtained by applying the rules.

'predicate'	'object'
cucoo:hasCulturalAssociation	erub:ituci_virtus_iulia/dj030941/assoc/indigenous/carving
cucoo:hasCulturalAssociation	erub:ituci_virtus_iulia/dj030941/assoc/punic/iconography
cucoo:hasCulturalAssociation	erub:ituci_virtus_iulia/dj030941/assoc/roman/language
cucoo:hasCulturalAssociation	erub:ituci_virtus_iulia/dj030941/assoc/indigenous/material
cucoo:hasCulturalAssociation	erub:ituci_virtus_iulia/dj030941/assoc/iberian/hairstyle
cucoo:museumCulturalContext	erub:cultural_context/Roman
cucoo:museumCulturalContext	erub:cultural_context/Iberian

Table 7.2. Inferences obtained for object dj030942.

As seen in Table 7.2., the object has five cultural associations identified by the different cultural traits perceived in the object. Each of the associations are identified with a URI. This URI is then defined with `cucoo:hasFeature` and `cucoo:value` and also associated with the cultural identity that can be perceived in the specific cultural trait. In this way, the description of the object and the cultural association is more flexible, and the queries can be more specific. The associations generated in ERUB can also be resolved in the database to obtain more information about them as well as the cultures they are associated with (Fig. 7.11).

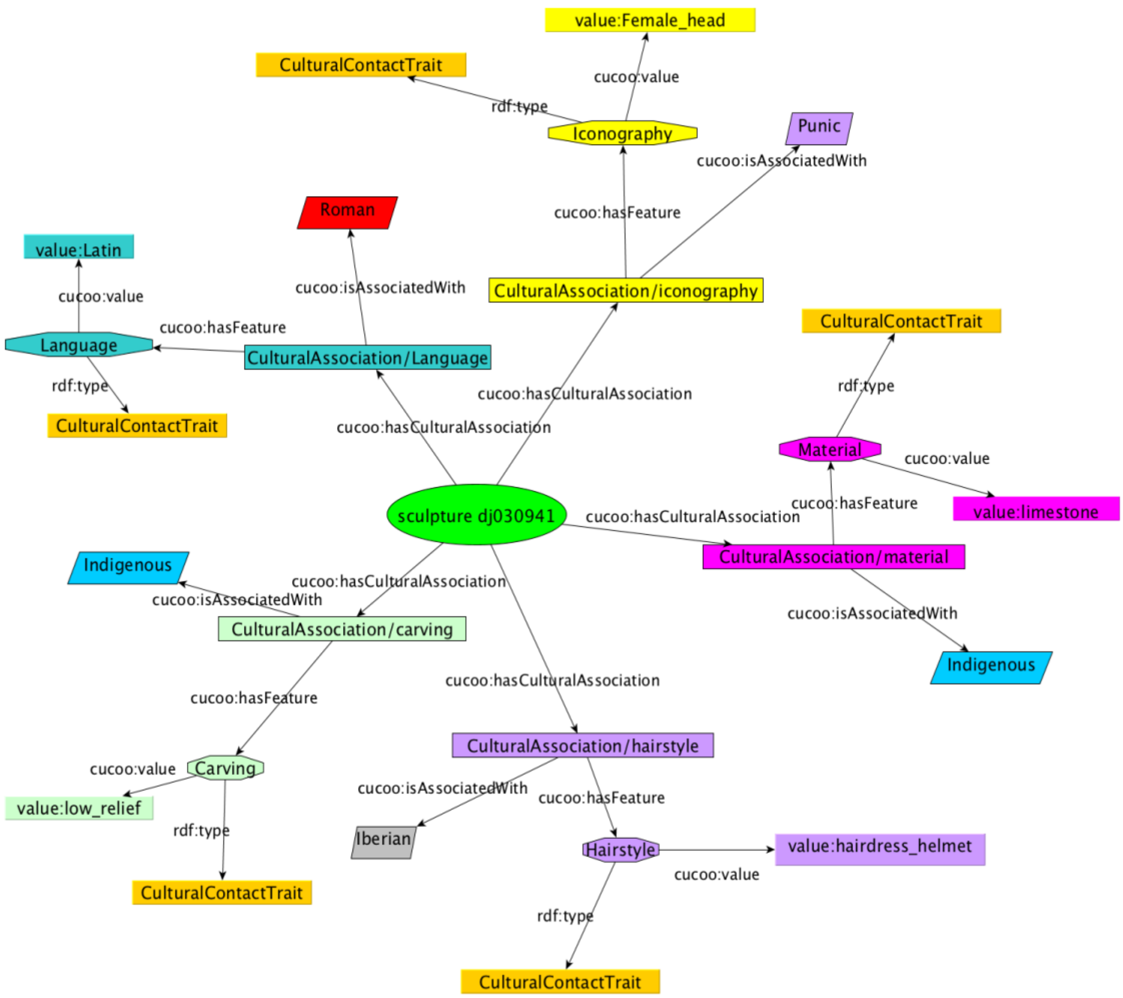

Fig.7.11. Visualisation of the cultural associations for object dj030941.

Fig. 7.11 shows the value and features provided by each of the associations. First, the material (limestone) is associated in the database with indigenous manufacture. Second, the carving style (low relief) is associated with local workshops. Third, the feline-alike features of the face have been related to Punic iconographic influence. Fourth, the Latin inscription of the forehead is interpreted as a Roman cultural trait. Finally, the carving style of the hair is interpreted as an Iberian influence. This is, therefore, an example of an object that displays indigenous, Punic, Iberian and Roman influence. In this case, the piece also depicts a 'person' which could be a representation of the offerer or of the goddess depicted in the writing. When that person's record is explored in the database, more results are provided, such as their gender, hairstyle, accessories and clothes if applicable. The following table shows the data about the person identified in the sculpture. The variables 'p' and 'o' stand for 'predicates' and 'objects' and are just used to retrieve all the information available about person-262[148] displayed in table 7.3.

predicate	object
rdfs:label	'limestone sculpture depicts a person'
cucoo:hasGenderIdentity	'Female'
cucoo:hasAccessories	'hairdress/helmet'
cucoo:hasHairStyle	'Long with a hairdress'

Table 7.3. Data about the person identified in object dj030941.

This way of collecting and structuring the data allows a more faithful representation of the reality of the objects as well as more prominence for other sorts of cultural influences in the area, while allowing the user to spot those areas with a major convergence of objects with many different cultural influences as we shall see in the analytical chapters 8 and 9.

[148] http://data.open.ac.uk/erub/depiction/person-262.

7. 7. Conclusions.

This chapter has offered a comprehensive account of the steps followed in the design and further development and implementation of the CuCoO ontology. It also expanded upon the rationale behind CuCoO and the theoretical justifications for the election of certain terms and concepts over others. The rationale behind CuCoO consists of complex anthropological theories of art history as well as controversial questions regarding the concepts of culture and ethnicity and how both of these interact with material culture. Hence, this chapter constitutes the documentation of the choices I made in the design of CuCoO and the justification for such choices. All the terms used in the representation of cultural concepts in CuCoO are debatable and could be exchangeable with others in different contexts.

CuCoO has been designed and developed with the aim to model and identify cultural contact in a dataset of archaeological evidence from early Roman Spain. The main mechanism to identify cultural contact in CuCoO relies on the identification of cultural features from diverse provenance in one and the same object. This is done by the connection of the class `cucoo:CulturalTrait` to one of the instances of the class `cucoo:CulturalIdentity` through the property `cucoo:isAssociatedWith`. In this way, the objects that present cultural traits related to different cultural identities are considered in CuCoO as evidence for cultural contact. This is the main contribution of CuCoO and what makes it different from any other data models that may deal with cultural representation and cultural interaction.

The inference rules explained in the last section of the chapter are used to infer new data from the already-existing records, this is deducing new information from what is implicitly modelled in the source data. These inferences made the ontology behave in a specific manner that allowed it to infer the sort of knowledge that it was constructed to. This also means that rules defined for a specific inference should not be taken as universal reasoning postulates. Because of this, it is important to note that the rules developed in this research are mainly to be applied in the data provided by the ERUB dataset under the premises of the chronological and geographical framework in which that data has been obtained and not any other dataset. This clarification can also trigger certain conclusions regarding the power of inferencing of LOD. Much has been said regarding the potential benefits that inferencing could bring to archaeological research. Isaksen (2011, 154-155), after considering inferencing as one of the benefits of Knowledge Representation, hypothesised that archaeologists may still be sceptical of fully automated processes of logical deduction. The author concluded that since the processes use a Rule language to define the categories only on the bases of the attributes specified, it is hard to argue that inference generates new archaeological information.

As previously said in this chapter, CuCoO should not be seen as the definitive representation of the domain of cultural contact but as a tool to explore this question by means of digital technologies and to see what further insights can be obtained from it. In terms of technical expertise, for the development of CuCoO ontology, it was necessary to acquire competent knowledge in ontological modelling, as well as the management of the Protégé software that was used for the design of CuCoO.

Chapter 8: Cultural Contact in the epigraphic record

Overview

Chapter 7 discussed the design and development of the Cultural Contact Ontology (CuCoO) with a significant focus on the rationale and the theoretical framework. Having concluded the methodological section of this thesis (constituted by the collection and integration of data for the generation of ERUB, and the design and implementation of CuCoO), the following chapters 8 and 9 focus on the evaluation of the methodology. Chapter 8, as the first part of this evaluation, applies the SPARQL query language on the ERUB dataset to explore cultural dynamics on the epigraphic evidence (especially looking at onomastics and coin legends). Using SPARQL, I will query the dataset to explore the question of cultural contact in the epigraphic record collected in ERUB, the results will be visualised and compared with previous research to draw conclusions on the potential benefits and pitfalls of the method.

8.1. Linguistic Contact

The cultural diversity of the Iberian Peninsula before the arrival of the Romans and its influence on the later cultural transformation of the groups in the territory has been previously noted (Beltrán Llorís 2016). One of the fields in which such diversity can be best perceived is in linguistics (e.g., Herrera Rando 2019, Cruz Andreotti 2018, Estarán Tolosa 2016, Beltrán Llorís 2016, Beltrán Lloris/Estarán Tolosa 2011). The linguistic panorama in the Iberian Peninsula around the 4th to 3rd centuries BCE contrasts significantly with the uniform situations documented in adjacent regions of North Africa – where Libyan languages prevailed – or Gaul – where Celtic languages prevailed apart from the southern areas (Beltrán Lloris/Estarán Tolosa 2011, 10). As of March 2020, the number of Paleohispanic inscriptions conserved on the peninsula reaches a total of 2,500. Of these, only 12 have been considered purely bilingual inscriptions, 0.3% of the total (Estarán Tolosa 2016; Beltrán Lloris/Estarán Tolosa, 2011, 10). This could be considered striking given the linguistic diversity and epigraphic culture of the peninsula. Nevertheless, the total number of bilingual inscriptions in antiquity is also very low (Estarán Tolosa 2016). In contrast to Hispania Citerior, the province of Hispania Ulterior shows a very varied panorama of linguistic influences in which colonial languages such as Latin or Phoenician/Punic are entangled with indigenous tongues epigraphically documented such as Iberian and possibly Turdetanian or Tartessian (as attested by the onomastics) in different media and demonstrate a varied range of linguistic phenomena from bilingualism to code-switching and mixed texts (Beltrán Lloris/Estarán Tolosa 2011).

Linguistic contact takes place when speakers of different languages interact and hence exert an influence on each other. It is widely recognised that different sorts of linguistic contact have taken place during human history. The exchange of influences between languages not only shapes the way in which language itself develops but also the way in which culture develops, and thus the way in which individuals interact with the world around them. Language contact is not a 'monolithic' occurrence but consists itself of a varied range of phenomena. Mullen (2012) summarises the main bilingual phenomena into: a) borrowing of elements from other languages, b) interference between Language 1 and Language 2 and c) code-switching or (switching between languages in one and the same text).

The study of linguistic contact in antiquity has always been of interest. The research done by Adams (2003), Mullen and James (2012), Mullen (2013 —Southern Gaul) and Estarán Tolosa (2016) is of special interest. What all these works have in common is the focus on the concept of bilingualism —in some cases multilingualism— in antiquity, and the classification of the epigraphic evidence for bilingualism in the ancient world. The first classification of bilingual texts was made by Leiwo in Adams, James and Swain 2002 to classify Graeco-Latin inscriptions in Italy. Following Leiwo's enterprise, Adams (2003) made the first firm proposal for the classification of bilingual text in antiquity. His work has been recently revised by Mullen (2012) who considers the question of multilingualism in antiquity and proposes new formulations for certain of the classifications made by Adams as seen in the table below taken from Mullen 2012.

	1.Bilingual texts	***2.Texts implicitly reflecting bilingual situations***	***3.Mixed language texts***	***4.Transliterated texts***
A D A M S	Two separate parts in different languages and a content which is usually, at least in part, common to both.	'An 'implicitly bilingual' text is on the face of it in a single language, but there is reason to think that another language played a part in its formation'.	Texts showing any form of code-switching or code-mixing.	Composed in language A but the script is that of language B.
	1.Bi-version (/tri-version) bilingual (trilingual) texts	***2.Texts displaying bilingual phenomena***	***3.Mixed language texts***	***4. Transliterated texts.***
M U L	As above.	Composed in language A, but showing	Written in genetically mixed languages or codes	As above. Can include texts displaying

L E N		interference/code-switching/borrowing from language B.	that are so mixed that it is impossible to identify the dominant language.	bilingual phenomena or bi-version bilingual texts.

Table 8.1. Summary of Adams' (2003) proposition and Mullen's (2012) corrections.

The taxonomies proposed by Adams and Mullen are focused on the study of bilingualism in antiquity from a broad perspective, not only from the point of view of the analysis of the epigraphic sources but also the application of sociolinguistic approaches to study the types of bilingualism. However, this model implies that the classification is not systematically applied to the study of the evidence but rather proposed as a framework to study bilingualism in antiquity in its broader sense. The latest proposal, summarised in the following table, was made in 2016 by Estarán Tolosa.

	1.Trilingual inscriptions		***2.Bilingual inscriptions***	
	Type 1	***Type 2***	***Type 1***	***Type 2***
E S T A R Á N	Epigraphs consisting of 3 enunciations of identic content written in 3 different languages.	Epigraphs consisting of 2 (or 3) enunciations written in 2 (or 3) different languages where the information is not identical in each version (there is more information in one version than in the other).	Epigraphs consisting of 2 enunciations of equivalent content written in 2 languages.	Epigraphs consisting of 2 enunciations of equivalent content written in 2 different languages.

	3. Mixed inscriptions				
	Type 1	**Type 2**			**Type 3**
		A	B	C	
	Epigraphs consisting of 1 enunciation written in 2 languages. These inscriptions reflect code-switching.	Epigraphs written in an indigenous language that finish with a Latin formula. These inscriptions reflect formula-switching.	Epigraphs written in Latin that finish with a formula written in an indigenous language. These inscriptions reflect formula-switching.	Epigraphs written in an indigenous language that finish with a Latin formula. But that also include Latin in the body of the text.	Epigraphs consisting of 2 enunciations written in 2 languages that are clearly related.
	4. Inscriptions of undetermined type				
	This category includes inscriptions which cannot be included in any of the types above since there are not enough arguments to support any sort of classification.				

Table. 8.2. Estarán's 2016 classification (translated by the author).

In contrast to Adams and Mullen's terminologies, Estarán's taxonomy emerges directly from the analysis of the evidence. She draws a classification deeply rooted in the inscriptions collected in the corpus to further analyse the reflection of phenomena such as bilingualism or Latinisation in them. According to Estarán, the examples that should be especially considered in the exploration of linguistic contact in antiquity are: a) digraph inscriptions, b) inscriptions that include the same enunciate in two different languages (bilingual inscriptions) c) inscriptions with code-switching (mixed inscriptions) and d) onomastic formulae.

Although linguistic contact seems to be a widely accepted phenomenon that shaped the languages and cultural behaviour of the Peninsula´s inhabitants from the 4th century BCE to almost the 1st century CE, it is still not quite clear to what extent the adoption of certain languages over others was an assertion of cultural identity or just a matter of efficiency in communication with the gods, the state or even a question of practicality to enhance the understandability of the message (Beltrán Lloris 2016, 133-134). Recent studies can still not provide the set of factors that determine the maintenance of a language in a bilingual environment; what is clear in the perspective of Mullen (2012, 25) is that the nature of the languages that interact and the linguistic similarities they share have an effect on the resulting linguistic outcomes.

In this respect, Mullen makes allusion to the concept of ethnolinguistic vitality defined as 'the vitality that makes a group behave as a distinctive and collective entity within the intergroup setting' (Mullen 2012, from Giles, Bourhis and Taylor 1977, p.317). The higher the linguistic vitality of a group, the higher possibility there is for that group to maintain its language (Mullen 2012, 26). Linguistic vitality can be measured in a different set of indicators that affect different variables in relation to the status of the community, the demography and the institutional support (Mullen 2012, 27). I am sceptical, however, about the possibility to extrapolate these variables to communities in antiquity and to measure it in different groups whose boundaries have not yet been defined.

Another factor taken into account at the time to consider the disappearance of vernacular languages is the situation of Latin as a 'language of power' that was assumed as the vehicular language by local aristocracies and later adopted by the rest of the population. In this matter, one of the main standpoints emphasise the role of Latin lapidary epigraphy, especially from the Augustan period onwards, as an instrument to construct the public image of Roman aristocracies (Diaz Ariño 2016). In this respect, Mullen has recently reflected upon the understanding of Latin epigraphy as a ‘killer’ of the epigraphic habit in other vernacular languages looking at epigraphic evidence from the western provinces of the Roman Empire (Mullen 2019). Whereas the situation in Britain and the Germanies demonstrates the imposition of Latin epigraphy over any possible epigraphic competition from indigenous languages, the case in the Iberian Peninsula and other areas earlier brought into the Roman ambit is quite different. In the case of Spain, where a multilingual epigraphic culture was already established before the Roman arrival, it seems to be under the power of Rome when the epigraphic complexity of the peninsula reaches its highest level (Mullen 2019). The following maps from the Hesperia database depict the epigraphic activity in the peninsula before and after Roman arrival.

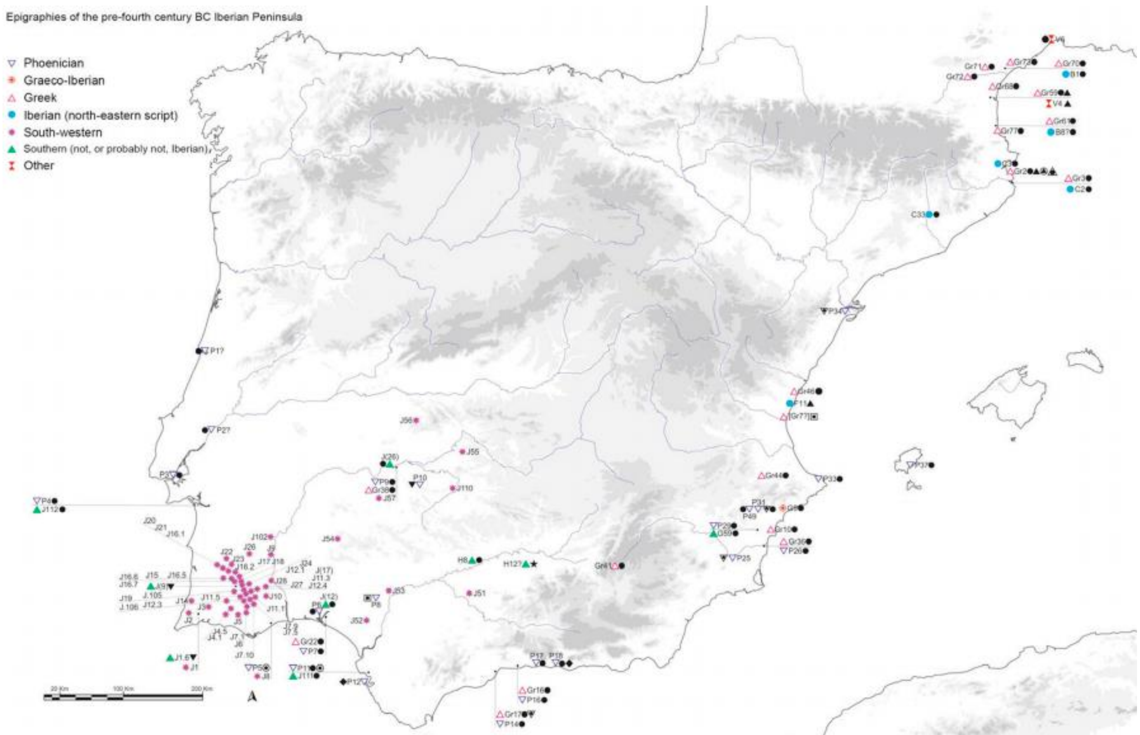

Fig. 8.1. Inscriptions on the Iberian Peninsula before the 4th century BCE. Source: Hesperia.

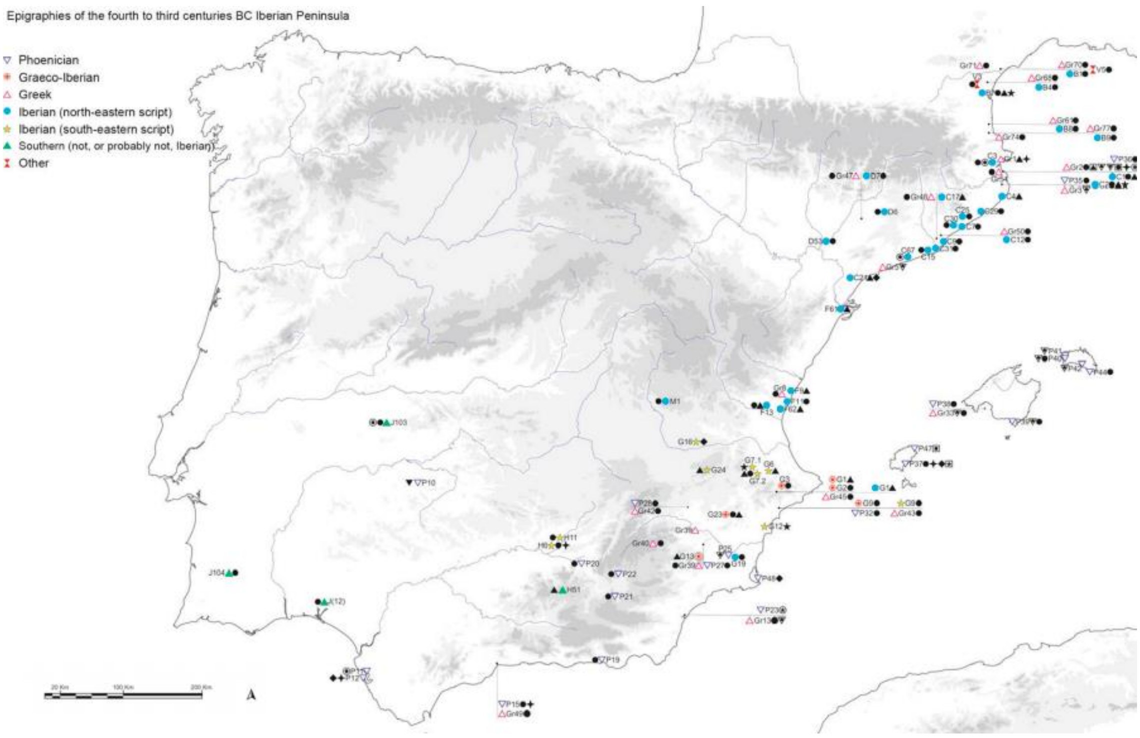

Fig. 8.2. Inscriptions on the Iberian Peninsula 4th-3rd centuries BCE. Source: Hesperia.

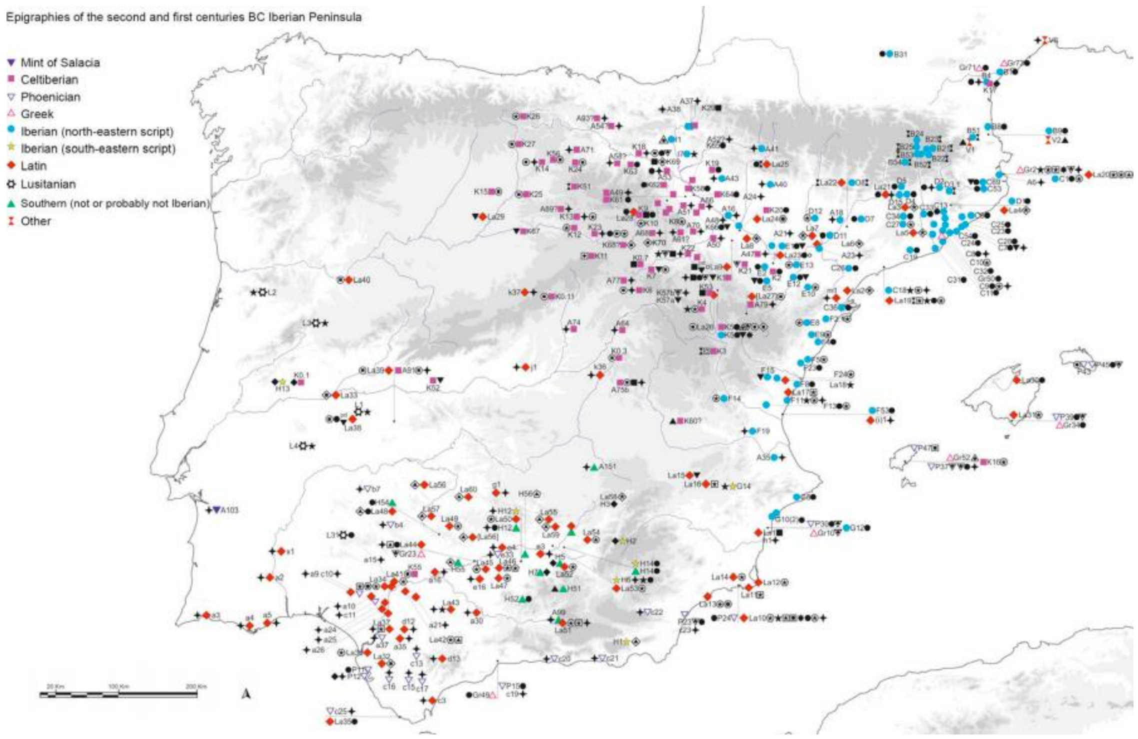

Fig.8.3. Inscriptions on the Iberian Peninsula 2nd-1st centuries BCE. Source: Hesperia.

Around the 4th century BCE, the epigraphic production seems to be focused on the north-eastern and eastern coast with the presence of Greek and Phoenician inscriptions, also manifested in the south and with a special concentration of inscriptions in the south-west.[149]

From the 4th to the 3rd century BCE the landscape is reconfigured around the eastern coast where Iberian emerges in two different variants of the Paleohispanic syllabary, namely a variation of Greek and perhaps a variant of Iberian. It seems the commercial contact with Greek populations in the area stimulated epigraphic production in the south and levant (Panosa 199). It is still unknown, however, whether the early Punic presence in the area could have had an impact on the rise of the Levantine Iberian epigraphic production.

Finally, map 3 displays the expansion of epigraphic culture in the peninsula from the 2nd century BCE and after Roman arrival, that instead of diminishing with the insertion of Latin epigraphy, increases critically showing a very different situation to that displayed in the other western provinces. In Citerior, the number of written inscriptions increases especially in Iberian language with the insertion of Celtiberian text in the north-east and with the spread of Lusitanian epigraphy in the east, both languages had not previously been written before the arrival of Latin.

In Ulterior, the epigraphic samples of the southern script increase exponentially together with South-eastern Iberian, Phoenician and Greek inscriptions on the coast in small numbers. As Mullen (2019) emphasises, although Roman presence clearly has a fundamental impact in the expansion of epigraphic activity in the area both in Latin and indigenous languages, the spread of epigraphic culture cannot only be attributed to the

[149] These inscriptions are written in the South-west script and have already been explained in Chapter 3. They have been dated as a group between the 6th and the 4th centuries BCE.

Roman influence but should be understood as a product of multiple internal and external cultural relations from the 3rd to 2nd centuries BCE which resulted from the cultural contact among the different communities. During the late Republican period and the first years of Augustus' reign, the slow imposition of Latin in the epigraphic culture of Ulterior can be perceived in detriment of the Paleohispanic languages that are now perceived in the onomastic record and residual characteristics in the Latin linguistic setting (Mullen 2019, 3-4). A very different case seems to be depicted by non-lapidary evidence such as coinage, where certain cities maintain the Punic legends of their coins until the early Empire, such as, for example Gadir, in Ulterior and Ebusus (Ibiza) this question together with the influence of indigenous onomastics in Latin epigraphy will be explored in this chapter.

8.2. The procedure

In previous chapters (i.e., 1, 5, 6 and 7) we have discussed the main advantages and disadvantages of using LOD technologies to implement archaeological research. Some of the main benefits of the implementation of this technology, as opposed to others such as relational databases, include more flexibility in the data modelling, easier data processability, interoperability, inferencing and research sustainability. These benefits have been discussed along this thesis in some cases also addressing their pitfalls and the costs of their implementation. The aim of this chapter is to apply the method suggested to assess its efficacy to explore the question of linguistic contact in the epigraphic evidence (i.e., onomastics and coin legends) in the province of Ulterior Baetica from the 4th century BCE to the 1st century CE.

The methodology chosen to explore this question relies on the LOD approach discussed in previous chapters (i.e., 5, 6 and 7) which consists of: first, the generation of a linked open dataset constituted by data consumed from web-exposed repositories and data integrated ex novo; second, the simultaneous implementation of a Cultural Contact Ontology (CuCoO) developed ad hoc to model and identify cultural contact in the evidence; and third, the querying and analysis of the results, which will also be compared to already existing research in the field. The application of the method to a specific research question will allow us to provide a more robust and evidence-based evaluation of the methodology to critically assess whether the method proposed is an efficient approach, together with its potential benefits and pitfalls. For instance, if the method provides demonstrably erroneous results or substantively less complete from those that could be achieved by other means, that might provide an argument that certain aspects of the method are not valid or present certain issues which could be related to the ontology, the dataset or other. Conversely, in those cases in which the method produces similar results to those arisen from previous scholarship, that might provide an argument that the proposed methodology is successful and constitutes an efficient approach with potential benefits for its application in this specific case.

Chapter 8 relies on the application of SPARQL querying to the ERUB dataset to look for potential patterns of linguistic contact in a systematic way that can be perceived in the evidence. As with relational databases and SQL, SPARQL (SPARQL Protocol and RDF Query Language) is the query language for RDF data, it allows the user to ask questions to the dataset at issue. SPARQL queries search the dataset for the specific subset of data that meets certain conditions. The anatomy of SPARQL queries consists of several sections which require a certain order. Fig. 8.4. shows an example of a simple query with the different sections explained. The query requests the engine of Fuseki (Jena ARQ), to provide 50 values that are type `cucoo:Settlement`. In plain English, the query is asking for any entities that are treated as settlements in ERUB. The result will be a list of a sample of 50 of the settlements collected in the ERUB dataset as requested by the limit.

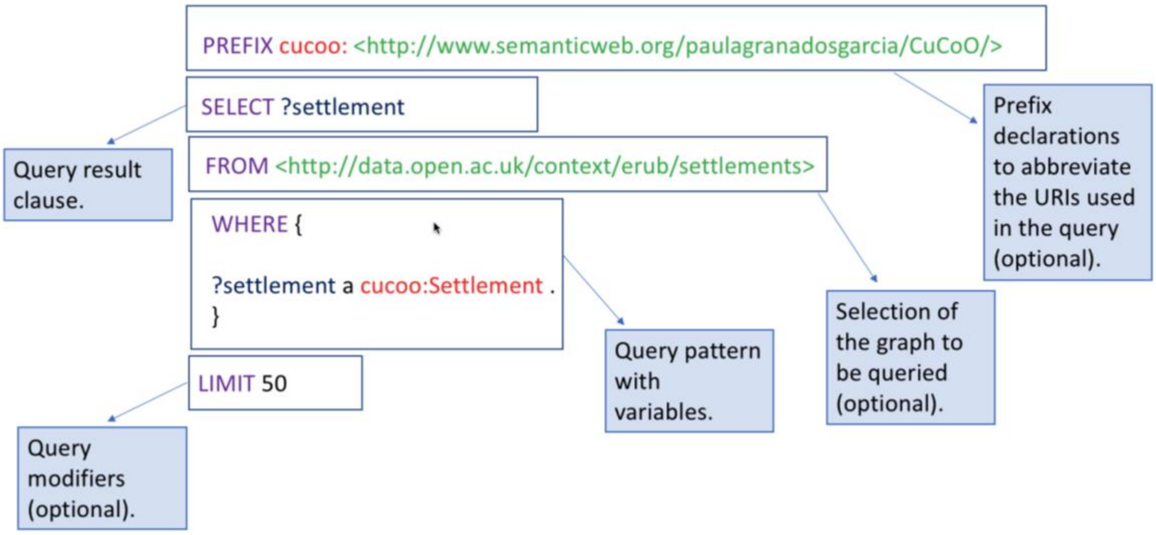

Fig. 8. 4. Anatomy of a SPARQL query divided in the different sections.

The query starts with the prefix declarations which define abbreviations for the namespaces. The Prefix statements simplify the syntax and will save space later if further predicates are added. Following the prefixes, the query result clause indicates the function of the query:

- **`SELECT:`** returns the variables and their bindings matching a particular graph pattern.
- **`ASK:`** checks whether a particular graph pattern or query pattern has a solution in our database.
- **`CONSTRUCT:`** constructs an RDF graph following a particular graph template.

- **DESCRIBE:** returns an RDF graph containing triples about one or more resources.

The four different query types are divided in two subgroups. The types `ASK` and `SELECT` provide tables of data for the pattern given. `CONSTRUCT` and `DESCRIBE` can provide new RDF triples when specifying the graph template. In the example query, the `SELECT` clause contains one variable ('settlement') preceded by "?" which retrieves the names of 50 items with type settlement in CuCoO. Following the query clause, the key word `FROM` restricts to the names of the graph that we want to query. In this case, we are querying Graph 1: Settlements,[150] but we could run the same query in the default graph and get the same results since the query pattern specifies the properties of the data to retrieve. Following the selection of the graph, the query has a single triple pattern to indicate the subset of the data requested. The pattern ends with a full stop like turtle triples, and consists of a variable (`?settlement`), a predicate (`a`) and an object (`cucoo:settlement`).

Variables tell the query engine that triples with any value in that position can match the triple pattern. The engine reads the query from bottom to top so those triples are then stored in the variable and used again in the query if needed until it is solved. The predicate (`a`) is a special case in SPARQL. The lower-case vowel (`a`) is a short way to express the property `rdf:type`. It is a shortcut offered in the syntax of Turtle, N3 and SPARQL that can make it much easier to understand the graph. In this case, the 'a' is used to reflect that the query is asking for all entities in ERUB that have the property `rdf:type` followed by the object `cucoo:Settlement`. The complete results of the query can be seen in Appendix 1, Test Query 3 in ERUB, where the query provides a table with a list of all the

[150] See section 6.4. for the description and numbering of ERUB graphs.

items that are considered as settlements in the settlements graph in ERUB under the `(?settlement)` label for the column with a limit of 50.

SPARQL is the standard query language protocol for LOD on the web, or semantic graph databases (also called triplestores). By using SPARQL, one can retrieve, obtain information, and modify data in several formats from graph databases. Furthermore, this query language can also be executed on any database that can be presented as RDF by the application of a middleware. For instance, one can use SPARQL to query a relational database using a mapping software to map the content of relational databases to RDF.[151] Because of this, the SPARQL query language is especially effective in terms of computational operations, filtering and other subquery functionalities.

In contrast to SQL, SPARQL is also an HTTP-based transport protocol. This means that queries in SPARQL are not constrained to be run in one single database, but they can be run on multiple endpoints. Federated queries can access any SPARQL endpoints by calling the URLs of the services in a sort of standardised transport protocol. Because of this, federated queries are one of the potential benefits of the application of LOD technologies to archaeological research.

This chapter deploys LOD technologies (ERUB database and SPARQL querying) to explore linguistic contact in early Roman Ulterior-Baetica on the basis of onomastics and coin legends. These have been selected as the best examples of linguistic contact since a) onomastics display an adaptation of indigenous names into Latin and b) coin legends display bilingual and mixed texts.

[151] For more information on the RDB2RD mapping software see https://www.w3.org/2001/sw/wiki/RDB2RDF accessed on August 2020.

8.3. Querying and analysis: onomastics

After Roman conquest, epigraphic culture expanded over the south of the peninsula and although the number of Republican inscriptions preserved in the southern area is not large, the sample is diverse (Diaz Ariño 2008). There is just one mixed inscription on stone preserved in Ulterior from the city of Castulo (CIL II.3294) but there are several samples including epitaphs and votive inscriptions that demonstrate the significant presence of the indigenous element in the area. Despite the apparent linguistic diversity, the only evidence of bilingual inscriptions in the peninsula shows a combination of Latin and the other vernacular languages, and none reflects any kind of contact between the indigenous languages themselves. This raises significant questions with respect to the expansion of Latin as a vehicular language and triggers certain assumptions about the lack of linguistic interaction between the other languages spoken.

Nonetheless, evidence suggests that linguistic contact amongst the vernacular languages occurred. This has been demonstrated by the impact that languages such as Phoenician had on Paleohispanic writings, the different influences displayed by the onomastic record of the area or the fact that the Iberian communities in the southeast used the Greek alphabet to write their own language (Beltrán Lloris/Estarán Tolosa, 2011, 11).

This section includes a selection of queries that explore the utility of the method to spot the evidence for linguistic contact in the epigraphic record of the province, especially in onomastics and coin legends. As it has been explained before (section 6.4 graph 4:epigraphy) ERUB is only constituted by one purely epigraphic dataset, the EDH epigraphic data, which has been directly ingested from the EDH open data repository, and a number of inscriptions recorded on sculptures which are part of the sculpture graph of ERUB. EDH only provides data about Latin inscriptions from the Roman provinces. Because of constraints of time and effort, it has not been possible to ingest any other epigraphic datasets of Paleohispanic inscriptions as LOD to be queried in ERUB with the rest of items. This does impede the comparison of the distribution between Latin and non-Latin inscriptions and demonstrates how in some cases, the non-implementation of LOD technologies can hinder research. Nevertheless, the comparison between the Latin and Paleohispanic corpus of inscriptions from the peninsula is not the only source to investigate the question of linguistic contact. In fact, the collection of Latin inscriptions itself can provide a significant amount of information, especially in the onomastic record, regarding how some indigenous names were adapted to Latin after the Roman arrival. This together with the dataset of coin legends from the peninsula that has been integrated for this purpose can provide a very rich collection to investigate linguistic cultural contact in early Roman Spain.

To get a notion of the sort of data collected in EDH, and since we are interested in the early stages of the province of Ulterior-Baetica, the first query (AQ.1.) provides a list of the oldest Latin inscriptions collected in EDH from the province of Baetica with a limit of 40. The results compile a collection of Republican inscriptions that, although in Latin, can still provide a significant amount of data regarding indigenous onomastics in the region. The query uses a geographical ID (to limit the results to the EDH ID for Baetica) and a chronological filter (to limit the results to any inscription produced BCE). The query provides a total of 91 inscriptions, a sample of 40 results are provided in Appendix 2:

Analytical query 1. The results have been visualised on a map created with the open-source software Carto[152] in Fig. 8.5.

Analytical query 1: What is the first evidence provided for linguistic interaction in the Republican period? Answered by finding the oldest inscriptions collected in EDH filtered by date and geographical coordinates.

```
# Definition of the prefixes
PREFIX lawd: <http://lawd.info/ontology/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX epi: <http://edh-www.adw.uni-heidelberg.de/edh/ontology#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>

# Select clause with variables required.
SELECT  ?inscription  ?startDate  ?endDate  ?place  ?label  ?latitude
?longitude

# Where clause to define the graph pattern that the data needs to
# match to be retrieved. The subject needs to be an inscription with
# start date and end date and be located in the EDH URI for Baetica.
WHERE {
?inscription a epi:inscription ;
   nmo:hasStartDate ?startDate ;
   nmo:hasEndDate ?endDate ;
lawd:foundAt/skos:broader*
<http://edh-www.adw.uni-heidelberg.de/edh/geographie/900030> ;
lawd:foundAt ?place .

# Having requested the place, retrieve the geographical coordinates.
?place rdfs:label ?label ;
geo:location [ geo:lat ?latitude ; geo:long ?longitude ] .

# Filter to retrieve only inscriptions dated before BCE
# and display in descending order from earlier to later.
Filter ( ?startDate <= “0000” )
}
ORDER BY DESC(?startDate)
```

152 https://carto.com/

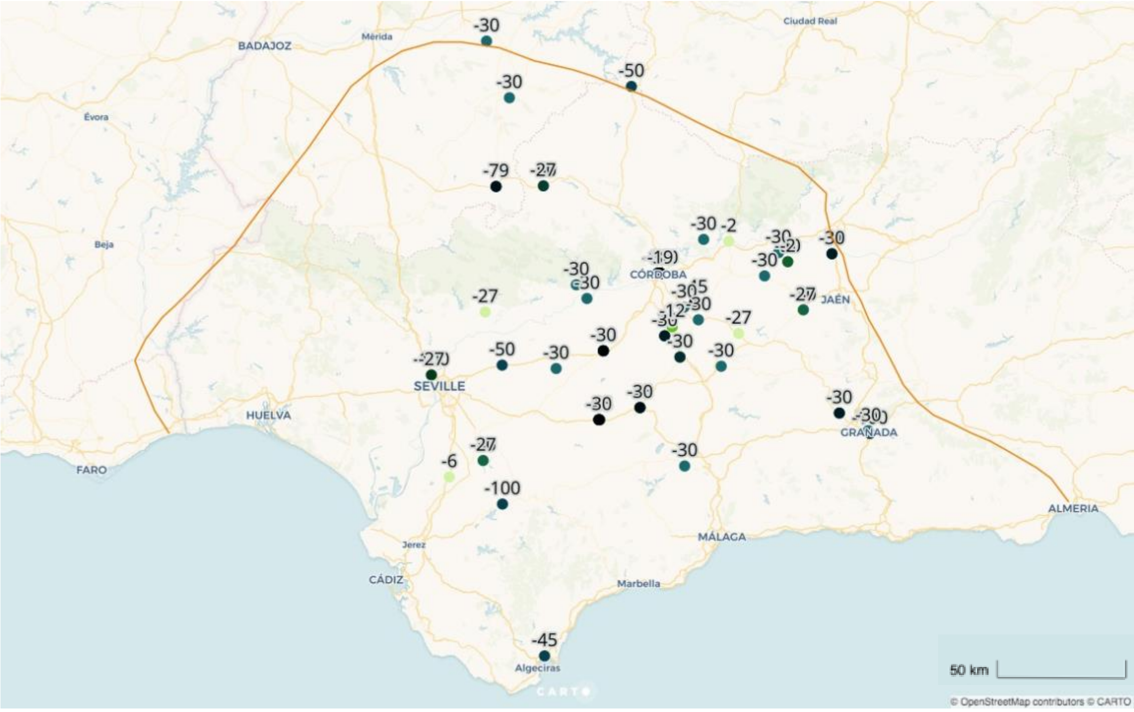

Fig. 8.5. Results of AQ.1 visualised on a map that shows the locations of the earliest Latin inscriptions in the margins of Baetica according to EDH. The darker colours for the points represent the earlier inscriptions with the start dates indicated in the labels.

Table 2 in Appendix 2 shows a sample of 40 items from the 90 results obtained. From the map, we can see a majority of inscriptions grouped around the Guadalquivir Valley with special concurrence in settlements like Urso (Osuna, Seville) (5 inscriptions) and Corduba (Cordoba) (14 inscriptons). The oldest examples date between 130 and 50 BCE. The clustering of inscriptions in the Guadalquivir Valley is by no means surprising due to the importance of the fertile river throughout history as a focus for the establishment of different communities. What is surprising, however, is the low presence of inscriptions in coastal settlements such as Gadir, Carteia or Malaka that coined their own money and played a fundamental role in the economic development of the area. Herrera Rando (2019) attributes this lack of Latin inscriptions on the southern coast of the province to the impact of a previous Phoeno-Punic epigraphic culture in the area that would have been unwilling to use epigraphy in public spaces (Herrera Rando 2019, p.102).

The data provided by EDH allows us to see the earliest Latin epigraphs in Baetica. Nevertheless, as discussed in Chapter 3, the first examples of indigenous Paleohispanic written language appeared in the Peninsula in the southwest around the 7th century BCE. The area was occupied by the Tartessian people at the time and their writing seems to be an adaptation of the Phoenician alphabet for the local language. The evidence for this 'Southwest' script includes some graffiti made on pottery and numerous *stelae* all dating to before the Roman presence in Hispania (Untermann MLHV, pp.93-348). This script is thought to be the predecessor of almost all the later Paleohispanic writing systems developed on the Peninsula, and so we might suppose that the area acted as a radiating focus towards the groups in the higher areas of the Guadalquivir Valley that adapted the same script to write the Iberian language (Fig. 8.6). LOD is not available for the Paleohispanic inscriptions and so evidence must be taken from Hesperia, source of the map provided in Fig. 8.6. which was also reaccessed in Chapter 5.

In the map (Fig.8.6) we can see how in the area of Ulterior-Baetica, Iberian inscriptions are not very significant with most examples being from the provinces of Cordoba and Jaén. However, this again should not be taken as proof for a reduced epigraphic culture in the south, since, there is evidence to suggest that epigraphic practice was well-developed in the area before the Roman arrival as suggested in written sources, e.g., Strabo's mention of the Turduli (III 1, 6) as 'the most educated community amongst the Iberians who not only practice the writing but who also have historic chronicles' (3.1.6).

Instead, the low occurrence of inscriptions in the area could be due to the use of perishable materials (Herrera Rando 2019; Diaz Ariño 2008, hypothesis by Beltrán Lloris 2011).

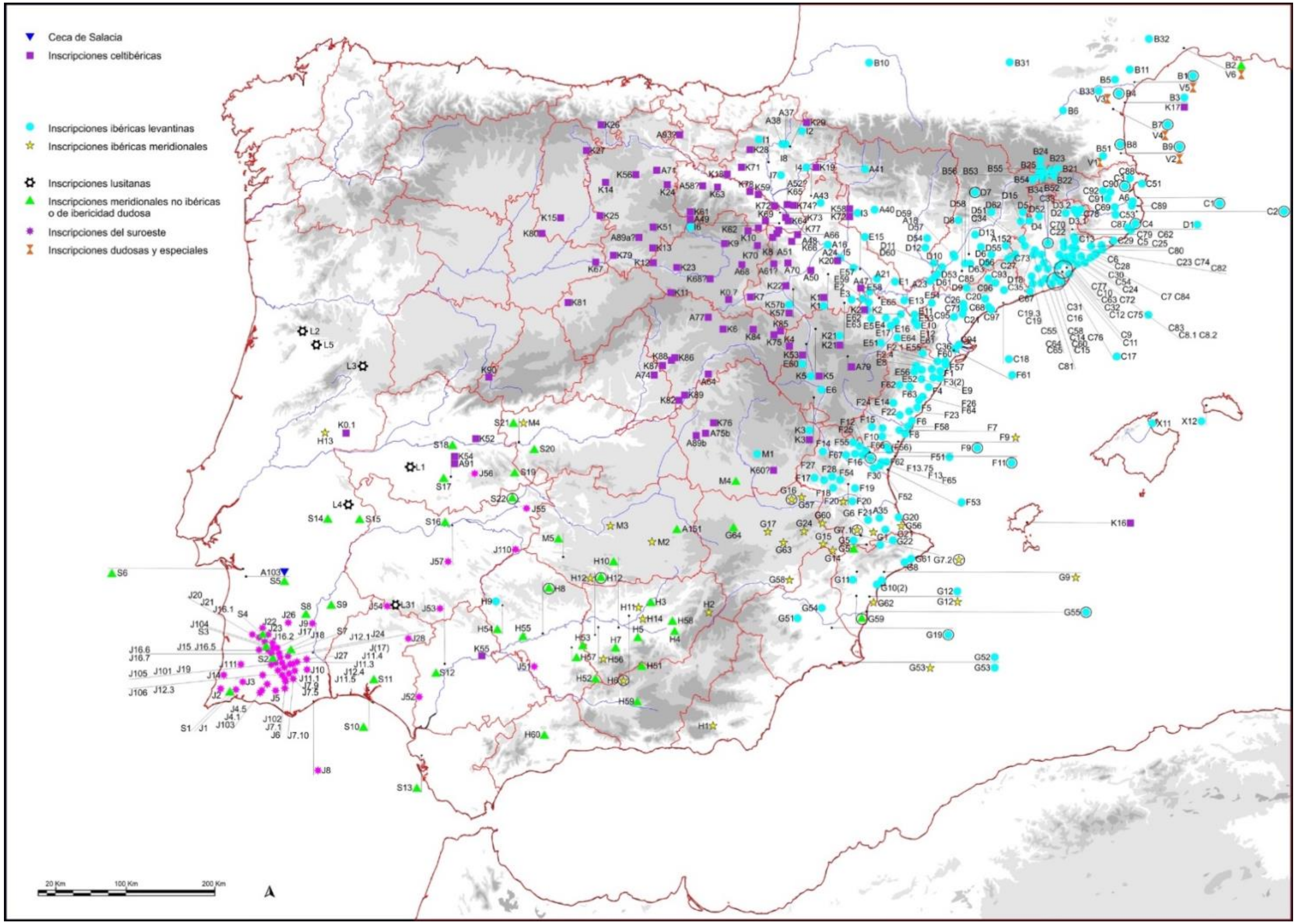

Fig. 8.6. Spread of Paleohispanic indigenous inscriptions on the Peninsula. Source: Hesperia.

The map produced with the data from AQ.1 shows how Latin epigraphy spread across Ulterior-Baetica from the first half of the 2nd century BCE (according to the dates provided by EDH). The adoption of Latin on the peninsula has been related to the fast integration of the indigenous elite in the Roman groups that used Latin as the official language, triggering the Iberian language to lose its function as a language of public self-representation (Diaz/Estarán/Simon 2019). This phenomenon would have also been influenced by the military groups in the area and the increasing settlement of Italic communities in the south, who took advantage of the colonizing policies of Caesar and Augustus, especially in the urban areas where epigraphic culture was more extensive (Diaz Ariño 2008, 33).

In Hispania Ulterior, the oldest official inscription written in Latin is a bronze plaque that contains the declaration of Aemilius Paulus from 189 BCE (CIL II 5041) and was found in the indigenous settlement of Lascuta (Diaz Ariño 2008, 39; García Riaza 2005). This inscription, however, does not seem to be recorded in EDH, where the oldest example dates back to 130 BCE. The lack of relevant inscriptions in the EDH repository should be taken into account to assess the accessibility of the research and the completeness of the data available.

Fig. 8.5. (map obtained from AQ.1) shows the clustering of the earliest Latin inscriptions in the north half of the region. These seem to date to the last half of the 2nd century and include small graffiti, medium-sised texts and a varied sample of media. Among the sample, a small graffito constituted by two single capital letters made by incision [---?]AL[---] is the oldest recorded in *EDH* (HD029195, *CIL II2/7, 630*). The text was written on a piece of Campanian B pottery. Although cautiously, we can say that it seems to be a

graffito of ownership. The inscription was found in the filling under the stairs of the Roman temple of Cordoba. According to Strabo (3.2.1.), the Roman city of Corduba (Córdoba) was founded by Marcellus, (possibly the Claudius Marcellus who was praetor of Hispania Ulterior and Citerior between 169-168 BCE), with groups of Italics and indigenous peoples in the area of Turdetania.[153] The first Roman settlement in the area took place in the earliest stages of the conquest (2nd century BCE) when the concept of colony itself was still developing on the Italian peninsula. The classical sources attest the foundation of a Roman colony next to an important 'Turdetanian' *oppidum* (Jiménez/Carrillo 2011, 54). The city was therefore probably inhabited by a heterogenous population including Roman citizens, Italics, Turdetanian and very probably mixtures between the different groups.

Similar examples of this kind of ownership graffiti have been found in nearby settlements within the province of Cordoba such as Ituc(c)i Virtus Iulia (Torreparedones) between Castro del Río and Baena (Cordoba). There is a big concentration of inscriptions in Torreparedones, including graffiti. EDH data provides information about the language and the type of support. To see how this data can be queried and analysed, the following query explores the text and the support of the inscriptions found in the settlement of Ituc(c)i Virtus Iulia (Torreparedones) according to EDH and ERUB. The query provides a total of 14 inscriptions provided in Appendix 2: Analytical query 2.

[153] There is still controversy over whether Cordoba was the first Roman colony in Spain, for further detail on this discussion see Jiménez/Carrillo 2011; García 2009.

Analytical query 2: What is the support and text of the oldest inscriptions found in Torreparedones? Answered by providing the oldest inscriptions collected in ERUB filtered by geographical coordinates plus main support.

```
# Definition of the prefixes
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX epi: <http://edh-www.adw.uni-heidelberg.de/edh/ontology#>
PREFIX cucoo: <http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>
Prefix lawd: <http://lawd.info/ontology/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX epi: <http://edh-www.adw.uni-heidelberg.de/edh/ontology#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
PREFIX rs: <http://www.researchspace.org/ontology/>

# Variables required
SELECT ?inscription ?startDate ?endDate ?support ?script ?language
?text

# Define the graph pattern that the data needs to match to be
# retrieved. The subject needs to be an inscription with start date,
# end date, support and must have been found in Ituci.
WHERE { {
?inscription a epi:inscription ;
   nmo:hasStartDate ?startDate;
   nmo:hasEndDate ?endDate;
   epi:representsTypeOfMonument ?support ;
   epi:hasEditionText ?text ;
   lawd:foundAt
<http://edh-www.adw.uni-heidelberg.de/edh/geographie/3345> ;
} UNION
# specification of a different graph pattern to retrieve similar data
# from the sculpture graph in ERUB for the settlement of Ituci.
{ ?support a cucoo:sculpture ;
   nmo:hasStartDate ?startDate;
   nmo:hasEndDate ?endDate;
   lawd:foundAt
<http://data.open.ac.uk/erub/settlement/ituci_virtus_iulia/118> ;
   cucoo:hasInscription ?inscription .
 ?inscription crm:P128_carries ?text ;
    crm:P72_has_language ?language ;
    rs:PX_inscription_script ?script ;
```

```
# Filter by inscriptions dated between 200 BCE and 1BCE.
  filter (?startDate >= -200 && endDate < 0)
 } }
```

The structure of this query should be explained further as it carries important consequences to the data results that will be obtained. The query is retrieving inscriptions found in Torreparedones dating between the 2nd and 1st centuries BCE, the support where those inscriptions where made, and the text they carry. In the first graph pattern, the query retrieves the dates when the inscriptions where made and not the dating for the supports. EDH cannot provide the dates of the supports because the dataset does not collect information about the monuments where the inscriptions where made beyond the type of monument (e.g statue base, stelae) and the material.

The UNION keyword in SPARQL allows the specification of a different graph pattern to then retrieve the data that matches any of the patterns specified. Using the UNION keyword here, the query also looks for those inscriptions made on statues collected in ERUB, dated to the same period, and found in the same location, using the ERUB URI for the settlement of Ituci. In this way, the query retrieves the data from EDH and also the data that matches similar characteristics from ERUB. The variables for language and script are only used in the second graph pattern, because ERUB´s inscriptions data provides information about the language and script in which the epigraphs were made.

As seen in Appendix 2: Analytical query 2, the query provides a table with inscriptions found in Itu(c)ci Colonia Virtus Iulia and dated between the 2nd century BCE and the 1st century BCE. The first 12 inscriptions are on urns and are dated to 30 BCE, the remaining ones are on sculptures collected in ERUB and belong to objects that have been dated to the 2nd century BCE. From the results of AQ.2, 9 out of the 12 inscriptions seem to record non-Roman names. At the site, significant archaeological remains have survived including the city wall, an indigenous sanctuary and two mausolea. Excavations in the shrine unearthed several structures dated to the 4th century BCE (Fernández Castro; Cunliffe 1998 231-337). In the vicinity of these structures, several votive offerings came to light, one of which represents a pregnant woman of which the head has been lost. The piece records an inscription in Paleohispanic script, so it is not collected in ERUB. The inscription consists of only two symbols which have not been deciphered (Morena 1989, 64). The other two votive offerings have Latin inscriptions and shown in the following table.

'statue'	'label'	'iconography'	'text'
erub:dj030941	'limestone sculpture'	'feline_head'	'DEA CAEL (estis) IVS (sit)'
erub:dj030942	'limestone fragment'	'human_legs'	'N - AGALEAMCRETIANO ;'

Table 8.3. Votive offerings with Latin inscriptions from Torreparedones.

The first votive offering with inscription has already been mentioned (Chapters 6 and 7) and it represents a limestone female head on the forehead of which can be read DEA CAEL (estis) IVS (sit). The letters are very irregular capitals made by incision. The head has a square shape with the hair shaped around the face in the form of a helmet. The facial features are very schematic and antinaturalistic. The eyes are represented by two ovals roughly carved and quite large in comparison with the dimension of the head. The treatment of the different surfaces is striking while the face has been carefully polished, the surface of the hair is rough. The head has been dated between the 2nd and 1st centuries BCE. However, the differences between the carving of the face and the low incision in the text of the forehead could imply different dates for text and sculpture, indicating perhaps a later dedication of the offering. Diaz Ariño (2008, 225) dated the inscription to the 1st century BCE. It is also important to note that inscriptions on the forehead are very unusual in Italy, furthermore, there are no other similar examples of forehead inscriptions in the dataset, so although the inscription is Latin, the place chosen for it could also be understood as a sign of indigenous influence. In conclusion, this case is especially interesting since the inscription a) is a theonym, b) records in Latin letters the name of Romanised version of a Punic deity, c) is located in the forehead of the sculpture, something very rare in Italy and d) seems to be posterior to the sculpture.

Because of this, it will be interesting to see whether LOD can provide new insights into this piece. Traditional epigraphic research differs slightly from research in a Linked Open Database such as ERUB. Normally in a traditional epigraphic database questions are related with the terms selected and only results within the domain are obtained. Nevertheless, in this case, since ERUB combines evidence from very different domains, the range of queries that can be run in the dataset is much broader. It is possible to explore similar sculptural objects or votive offerings with inscriptions in the area, as well as similar objects that display some sort of relation with the deity as for example the iconography.

The following query (AQ.2.1) looks for similar objects in low relief in the area to see whether there is a concentration of such objects in specific areas. The query was run on ERUB and the results were represented in the following map (Fig.8.7). The SPARQL query is not included here to avoid repetition since it is just a variation of A.Q.2.

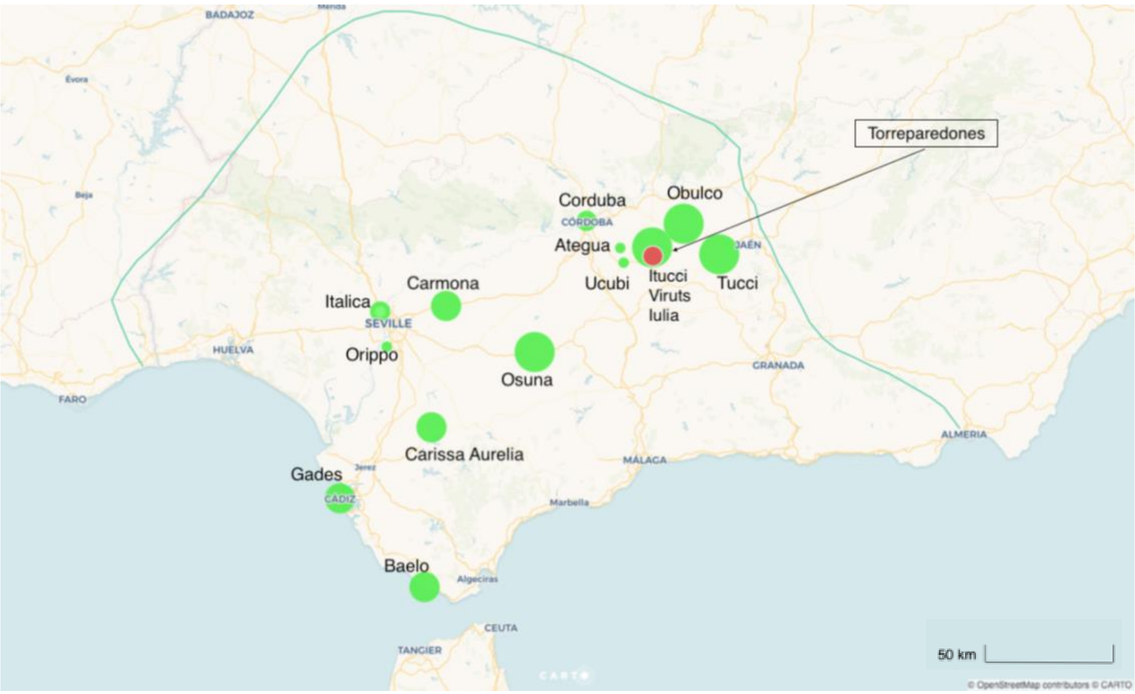

Fig. 8.7. Visualisation of the concentration of low relief sculptures in Ulterior-Baetica according to ERUB showing the boundaries of Baetica and the location of Torreparedones.

Fig. 8.7. reveals significant concentrations of pieces sculpted in low relief in settlements of Iberian or Punic tradition such as Obulco (Porcuna, Jaén), Urso (Osuna, Seville) or Carmo (Carmona, Seville). Apart from the sculpting technique, LOD also allows systematic querying for the iconography of the piece looking for other examples of the same type of representation. If both the inscription and the head were made at the same time, the dedication to Dea Caelestis, a Romanised form of the Punic Tannit, and the Hellenised Astarte, could mean the sanctuary was dedicated to the goddess.

The inscriptions found in the vicinity of the sanctuary of Torreparedones have to be added to another set found in a set of structures today known as the 'Mausoleo de los Pompeyos'. The excavations in the mausoleum brought to light a set of 13/14 urns made in stone, 1 made in glass and 2 made in pottery. The structure was in use to the first half of the first century BCE (Diaz Ariño 2008; Beltrán, J. 2000). Currently only copies of some of the urns are preserved. Five have been identified as belonging to *peregrini*, while the other seven belong to *cives* and record the tria nomina (Diaz Ariño 2008, 227). The last seven display the adoption of the Romanised name 'Pompeius' by the members of the family, whilst keeping their indigenous cognomina 'Icstnis', 'Nannae', 'Velaunis' which seem to be suppressed in later generations: 'Sabinus', 'Afer'.

Among the inscriptions that preserve the indigenous *cognomina*, 'Ildrons' and 'Velaunis' have been considered Iberian anthroponyms by some scholars (Albertos 1966), while others consider them non-Iberian meridional anthroponyms (De Hoz, 1989, 552-553). A similar situation occurs with 'Igalghis Ildronis F.', probably the son of another of the owners of the urns in the tomb of 'Ildrons Velaunis F.'. 'Igalghis' has no parallels in Spain but has not been considered Iberian (Diaz Ariño 2008, 228). The names are structured following the Roman formula to assume names for *peregrini* constituted by (personal name + patronym + f(ilius)). The ending in -is is a pattern common to all the names of indigenous origin. However, as this is also a flexion typical of Latin it is not possible to determine whether these examples should be considered as the Latinisation of indigenous anthroponyms or as a much less common prevalence of the indigenous declension (Estarán 2010, 108).

This sort of occurrence of indigenous names in the epigraphic record of a settlement of this kind implies a strong presence of indigenous families in the area that would have had important roles in the administration of the city, as two of the inscriptions record the magistracies 'Aedilis' and 'Iluir primus de familia Pompeia' (Diaz Ariño 2008, 230). The permanence of indigenous onomastica until the last half of the Republican period, implies a continuity of indigenous cultural assertions such as the self-representation of the individuals with indigenous names. This implies a desire to express certain assertion of belonging to the local community but also the integration into the new Roman system of citizenship as attested by the inscriptions with the *tri-nomina* probably produced after the privileged status was given to the community. LOD also allows to explore further specific names in the database to collect more specific information about one single inscription. To do this, we will first need a query to request the ID of the specific inscription that we are looking for (AQ.3) and then a second query to request all the data contained from that inscription.

AQ.3 can help to identify the presence of similar onomastics of non-Roman origin in the epigraphic documentation of Ulterior. In this case, the query explores those inscriptions that include personal names and requests both the inscription and its name. The query also filters the data by inscriptions found in Baetica and before the current era as limited by the filter. In contrast to traditional research, queries like this can save a lot of time to the researcher, since they provide specific personal names for a certain area and period. The information provided is also contextualised with information about the inscriptions and further references both in textual sources (i.e., CIL…) and other resources online (Hispania Epigraphica etc…). The query provides a total of 302 inscriptions, a sample of 100 results are visualised in Appendix 2: Analytical query 3.

Analytical query 3: What personal names are recorded in the earliest inscriptions? Answered by requesting earliest inscriptions in ERUB with personal names and chronological and geographical coordinates.
`# Definition of the prefixes`

```
PREFIX lawd: <http://lawd.info/ontology/>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX epi: <http://edh-www.adw.uni-heidelberg.de/edh/ontology#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
PREFIX cucoo: <http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX rs: <http://www.researchspace.org/ontology/>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>

# Variables required
SELECT  ?inscription  ?person  ?startDate  ?endDate  ?place  ?label
?latitude ?longitude ?name

# The subject needs to be an inscription with start date, end date
# and location and a person needs to appear in the text.
WHERE {
?inscription a epi:inscription ;
   nmo:hasStartDate ?startDate ;
   nmo:hasEndDate ?endDate ;
   lawd:foundAt ?place ;
   epi:hasPerson ?person .
?person foaf:name ?name .

# Filter by inscriptions dated before BCE.
FILTER (?startDate < 0 ) .

# The findspot has to be related to the EDH URI for Baetica and the
# geographic coordinates will be retrieved. The plus operator will
# match a chain of one or more skos:broader predicates.
?place skos:broader+
<http://edh-www.adw.uni-heidelberg.de/edh/geographie/900030> ;
   geo:location [ geo:lat ?latitude; geo:long ?longitude] ;
   rdfs:label ?label . }
```

As seen in the sample provided in Appendix 2 Analytical query 3, the query provides a large number of inscriptions with personal names, the dating, the place where they were found and the person name in them. As the number of results provided is very large, I have analysed the results and selected those names that display some sort of non-Roman influence. The following table displays those inscriptions that display non-Roman names together with the corresponding metadata according to EDH.

Inscription	Reference	start Date	endDate	Place	Name	Magistracies	Origin
edh/inschrift/HD 026626	CIL II2/7, 251	-30	-1	Corduba	Philemo		Greek
edh/inschrift/HD 026626	CIL II2/7, 251	-30	-1	Corduba	Heraclia		Greek
edh/inschrift/HD 026626	CIL II2/7, 251	-30	-1	Corduba	Irena		Greek
edh/inschrift/HD 026626	CIL II2/7, 251	-30	-1	Corduba	Epaphroditus		Greek
edh/inschrift/HD 026626	CIL II2/7, 251	-30	-1	Corduba	Aeschinus		Greek
edh/inschrift/HD 029195	CIL II2/7, 630	-130	-71	Corduba	-AL-		Indigenous?
edh/inschrift/HD 004001	CIL II2/5, 521	-49		Sabetum	Binsnes Vercellonis	Xvir maxs(umus)(!)	Celtic?
edh/inschrift/HD 004001	CIL II2/5, 521	-49		Sabetum	Acrini f. Alpis		Indigenous
edh/inschrift/HD 029728	CIL II2/5, 409	-30	-1	Torreparedones	Icstnis	II-uir	Indigenous
edh/inschrift/HD 029731	CIL II2/5, 410	-30	-1	Torreparedones	Aninna		Indigenous
edh/inschrift/HD 029734	CIL II2/5, 411	-30	-1	Torreparedones	Sabini		Indigenous
edh/inschrift/HD 029737	CIL II2/5, 412	-30	-1	Torreparedones	Nannae		Indigenous
edh/inschrift/HD 029740	CIL II2/5, 413	-30	-1	Torreparedones	Velaunis		Indigenous
edh/inschrift/HD 029743	CIL II2/5, 414	-30	-1	Torreparedones	Ildrons Velaunis f.		Indigenous
edh/inschrift/HD 029746	CIL II2/5, 415	-30	-1	Torreparedones	Igalghis Ildronis f.		Indigenous
edh/inschrift/HD 029752	CIL II2/5, 417	-30	-1	Torreparedones	Insghana		Indigenous
edh/inschrift/HD 029755	CIL II2/5, 418	-30	-1	Torreparedones	Sisean Bahannonis f.		Punic
edh/inschrift/HD 029758	CIL II2/5, 419	-30	-1	Torreparedones	Velgana		Indigenous
edh/inschrift/HD 029761	CIL II2/5, 420	-30	-1	Torreparedones	Canaeus	II-uir	Indigenous
edh/inschrift/HD 030584	CIL II2/5, 672	-100	-1	Iliberris	Asanan		Indigenous

Table 8.4. Analysis of the results provided by AQ.3. Each row corresponds to a different personal name, so one same inscription could correspond to different rows.

Table 8.4 displays the EDH ID for the inscription, the CIL reference, the dating, the place where the inscriptions were found, the names recorded in the text and it also includes two more columns which specify the origin of the onomastica and the indigenous magistracies. It is important to note that the two last columns (magistracies and origin of the onomastica) are not generated by the query, I have added them manually using previous scholarship on indigenous onomastica, in this case, the linguistic analysis carried out by Diaz Ariño (2008) and Herrera Rando (2019).[154] The information in this columns is not recorded by *EDH* but it provides the necessary points of comparison to look at linguistic contact in the evidence. This issue has implications to assess the completeness of the data provided by an LOD source such as EDH and the expectancies of the researcher when drawing on LOD resources. Although the data provided by LOD resources can be more contextualised and enriched than traditional sources, they will never substitute the researcher capability of comparison and analysis. We may use a SPARQL query to request data that leads to a specific question, and this question may lead to a different step, but LOD will hardly provide the final evidence for a research conclusion. These should be based on a careful process of examination of the evidence which in most of the cases will require other sources of knowledge for confirmation, as in this case.

As it can be seen in the table, the inscriptions record a total of 27 names of varied origins. There are examples of Greek onomastica, as well as what has been considered by Diaz Ariño (2008) as Celtic and indigenous. *EDH* does not provide all the examples of

[154] Herrera Rando and Diaz Ariño´s linguistic analysis of the onomastics will not be further discussed here for this not being only an epigraphic study.

potential indigenous onomastica written in Latin but just the ones coming from Ituci (Torreparedones, Córdoba), Sabetum (La Rambla, Córdoba) and Iliberris (Granada). These cases should be added to the rest of examples studied by Diaz Ariño (2008) including the inscriptions found in Italica (Santiponce), Corduba (Córdoba), Castulo (Linares, Jaén) Ilipa, Ilurco? (Pinos Puente) and Baelo (Bolonia, Cádiz). The 16 inscriptions identified here have to be added to the extra 14 inscriptions that record personal names according to Diaz Ariño (2008). These inscriptions are not collected in *EDH*, and therefore, they are not part of ERUB. However, they should be studied as part of the evidence for linguistic contact in Ulterior Baetica, so they will be included in this discussion. The inscriptions collected by Diaz Ariño (2008) have been visualised in the table below (8.5)

Inscription	Place	Name	Status	Sd	Ed	Origen
U4	Baelo	Acama		-130	-100	Greek
U4	Baelo	Paleohispanic symbol		-130	-100	Paleohispanic
U13	Castra Caecilia?	ATA		-100	-70	Indigenous
U24	Itálica	Ferrius		-50	-1	Etruscan
U25	Itálica	Herius		-50	-1	Etruscan
U26	Itálica	Volfernus		-50	-1	Etruscan
U27	Itálica	Aegantus		-50	-1	Lusitanian
U28	Ilipa	Attita		-50	-20	Indigenous
U28	Ilipa	Vrchail	Chilasurgun ?	-50	-20	Iberian
U49	Obulco	Senecianus		-50	-20	Indigenous
U50	Ilurco,	Vrcestar		-50	-20	Iberian
U50	Ilurco,	Tascasec		-50	-20	Iberian
U51	Ilurco,	Iunis Bo		-50	-20	Iberian
U57	Ilurco,	Iunius Bil		-50	-1	Indigenous
U53	Castulo,	Garos	civis	-100	-50	Iberian
U53	Castulo,	Vniaunin	peregrinus	-100	-50	Iberian
U53	Castulo,	Vininit	peregrinus	-100	-50	Iberian
U53	Castulo,	Cornelius Diphilus	libertus	-50	-1	Greek

U54	Castulo,	Socedeiauni n		-100	-50	Iberian
U54	Castulo,	Istamiuris		-100	-50	Iberian
U55	Salaria, úbeda.	Phrugia	libertus	-50	-27	Greek

Table. 8.5. Linguistic analysis made by Diaz Ariño (2008) on personal names collected in inscriptions from Ulterior Baetica. Each row records a different personal name.

As shown in Table 8.10, there seems to be certain examples of Etruscan onomastics in the city of Italica, a Roman colony founded by retired legionaries that stayed in the peninsula after the war. As Rodriguez Neila (1992, 180) pointed out, Italic names are dominant over Roman names in Hispania Ulterior, and this may be related to the presence of Italic *socii* who previously served as *auxilia* in towns like Carteia, Castulo or Corduba (Jiménez Carrillo 2011, 56). The names recorded in the inscriptions maintain the display an Etruscan *origo* 'Ferrius' and 'Herius' (Diaz Ariño 2008, p.210). This evidence should be considered an example of linguistic contacts between indigenous, Italic and Roman groups in Hispania. Another significant group consists of inscriptions that display Iberian and Greek onomastics. Iberian onomastics are more prominent in the subset of data taken from Diaz Ariño (2008) (Fig. 8.12). The table shows a collection of four examples considered of Iberian origins in the inscriptions U28, U50, U51 and U53.

The examples from the north of the province define a peculiar onomastic system featuring aspects that differentiate them from those in the rest of the peninsula, such as geminations, aspirations, and uncommon groups of consonants like in 'Insghana' or 'Ildrons'. Unusual stems also appear in examples such as 'Attita, Annina, Nannae' together with peculiar suffixes (-itt- and -ag-) (Untermann MLH IV, 167-168). The question remains whether this group should be included within the group of languages with Indo-European origin in the west of the peninsula such as Celtiberian or, on the other hand, with the languages in the east, similar or somehow related, to Iberian. Overall, the names do not really fit into the Indo-European models. However, there are also not clear features to include them into the Iberian language (Vallejo Ruiz 2009, 136).

As explained in Chapter 6, the examples analysed here come from the EDH database. These have been discussed together with the data collected by Diaz Ariño (2008) regarding Republican inscriptions. Because of this, although significant, the sample of results is not complete. In order to draw a more complete analysis I would like to include here the results provided by the onomastic section of the *Hesperia* database. As explained in Chapter 6, Hesperia does not provide LOD, nor the possibility to export data in a non-proprietary format that allows an easy conversion, making it difficult to develop a deep analysis on the evidence, and the only possibility is to copy here the results provided by a query developed in *Hesperia* with the same parameters to the previous one run in ERUB, that is, for all the names collected from the Southern area of the peninsula from 4th century BCE to 1st century CE.

The *Hesperia* database includes indigenous names recorded in both Latin and indigenous inscriptions. Although indigenous epigraphy does not necessarily imply cultural contact, it can provide insights into the epigraphic habit before Roman conquest. The results provided by *Hesperia* included several pages of names, so only a sample of the results are displayed in table 8.6.

Cognomen/single name	Affiliation	Family Unit	Place

		Caenicorum	Alcaracejos (CO)
Batalia			Guarromán (J)
Paquina	Nouatus		Jauja (CO)
Attuna	Eros		Jauja (CO)
			Morón de la Frontera (SE)
Adlenteus	Vnibele		Villanueva del Duque (CO)
Atausus			Villanueva del Duque (CO)
Aedistus Maurus			Cádiz
Aetolis			Sevilla
Agalean(---) ?			Baena (CO)
Albanus	Sunna		Las Cabezas de San Juan (SE)
Alipus			Córdoba
Amerio			Jerez de la Frontera (CA)
Amma			Cádiz
Anniola			Adra (AL)
Anniola			Utrera (SE)
Antarcyrus			Cádiz
Antiola	Diocharis		Osuna (SE)
Aplastus			Cádiz
Arantonius	Cilius		Santa Eufemia (CO)
Arauricus			Córdoba (literary name)
Aruacus			Almuñécar (GR)
Asanan			Pdesc. (Provincia de Granada ?)
Atitta			Carmona (SE)
Auseis			Cádiz
Auta (?)			Carmona (SE)
Auuo			Cádiz
Babis			Cádiz
Baccarus			Santiponce (SE)
Baria			Bailén (J)
Binsnes	Vercello		La Rambla (CO)
Bremusa			Pinos Puente (GR)
Caetina			Castulo (J)
Cala			Alcalá del Río (SE)
Capito	Sunna		Osuna (SE)
Cerdubelus			Castulo (J) (literary name)
Ceturgis (?)			Rute (CO)
Cieta			Córdoba
Clipius (?)			Córdoba
Concessa	Reburrus		Adra (AL)
Cognomen/single name	**Affiliation**	**Family Unit**	**Place**
Corduita Crestina	C.		Écija (SE)

Crillus			Úbeda (J)
Cusuccia			Sevilla
Chalaetus			Castulo (J)
Denatiaus (?)			Córdoba
Elapusa			Castilleja del Campo (SE)
Escossus (?)			Castulo (J)
Spalia			Marchena (SE)
Stelenus			Córdoba
Stis (?)			Sevilla

Table 8.6. Sample of results provided by Hesperia.

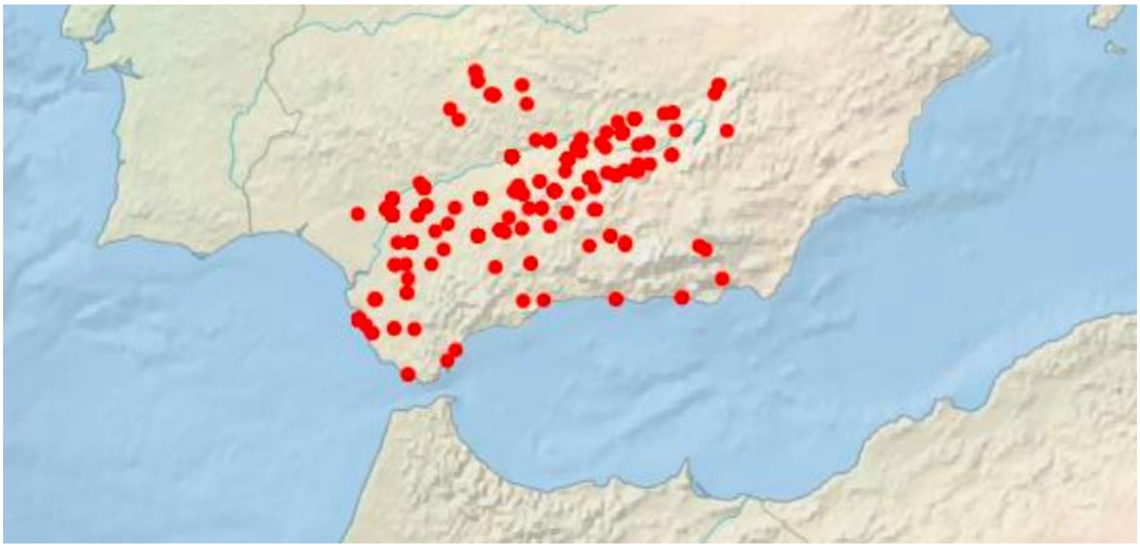

Fig. 8.8. Distribution of the results obtained from the Hesperia database map server.

Hesperia allows the visualisation of the results obtained in a map by using the map server of the interface, this is quite useful to map the inscriptions geographically, however, it does not allow to retrieve the geographic coordinates of the inscriptions to be plotted in a map locally. This would be preferable as it would allow to spatially compare the data with other sources and previously made analysis. The fact that geographical coordinates are not provided, points out another of the limitations of non-LOD implemented repositories. In this case, because of the lack of access, the user needs to rely on the Hesperia mapping service instead of creating their own map where to compare the results spatially.

Going back to the data, as shown in the sample, different indigenous names with varied linguistic origins are combined, however, *Hesperia* does not provide information about the possible origin of the nomenclature nor does it provide the dating of the inscriptions. Interestingly, the places that stand out from the rest for having concentrations of indigenous names are similar to those indicated by ERUB: Corduba, Obulco, Castulo, Italica, Ilipa, Ilurco, Ituci and Urso. New settlements not spotted before are Jerez de la Frontera, Astigi, Itucci and Carmo as seen in Fig.8.9. The names of the current provinces of Cádiz and Seville also have many occurrences, however, the precise locations of the find spots are not specified.

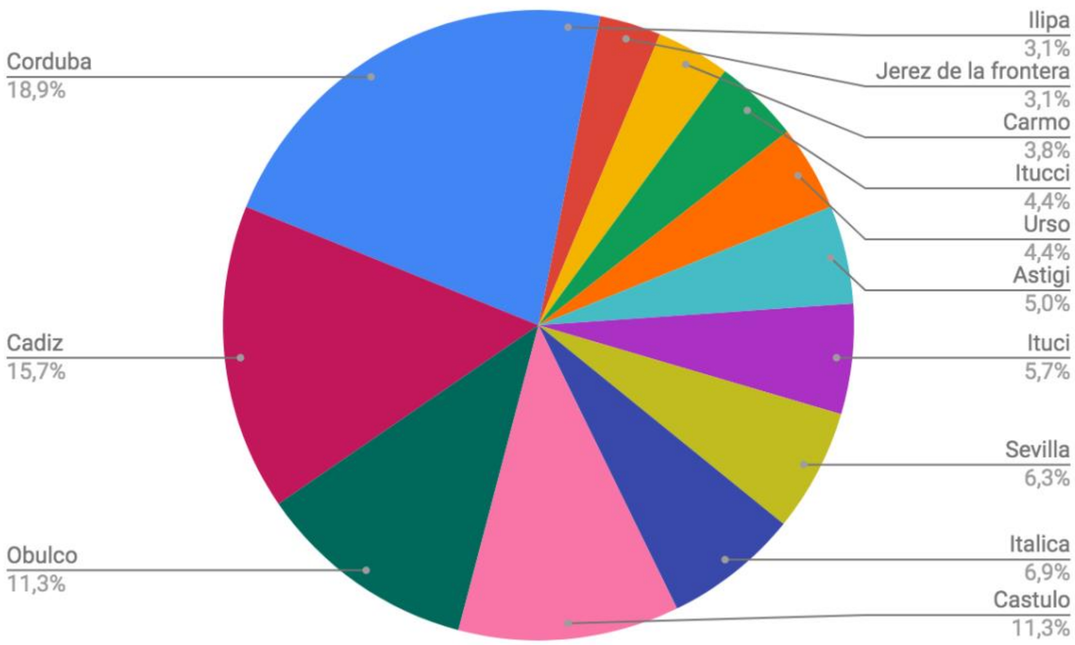

Fig. 8.9. Occurrence of indigenous names in the main settlements according to Hesperia.

Either way, the sample demonstrates significant numbers of indigenous names in the epigraphy of the province especially in the last period of the Republican era, and in comparison, to the evidence in neighbouring territories such as Citerior (Diaz Ariño, 2008 49). The question of mixed names has been somehow controversial in the studies of bilingualism and linguistic contact more broadly (see Estarán 2014, 21). It seems straightforward that the adoption of a name of a different origin in a specific language does not necessarily reflect bilingualism. In this respect, Poccetti (1988, 129) pointed out that although mixed onomastic formulae do attest a situation of cultural contact and therefore can be taken as evidence for 'biculturalism', they should not be understood as exact evidence for bilingualism as each culture has specific anthroponomic structures and the conversion of a certain name into another language does not necessarily imply a literal translation. Therefore, since the information provided in the onomastic formulae is the same in both languages, they should be taken as equivalent utterances and not as bilingual texts (Estarán 2014, 29). However, the question at issue here is not to what extent mixed names indicate bilingualism between the individuals who carried those names, but to what extent mixed onomastic formulae can be considered as indicators of linguistic contact, and hence, cultural contact.

Although onomastic formulae are not bilingual texts, they do demonstrate contact between communities with different mother tongues, and furthermore the adaptation of one of the tongues to comply with the main features of the other, especially regarding the script, and in some cases, the structure and declension. Onomastic formulae also demonstrate some sort of acknowledgment of the linguistic differences amongst the two linguistic structures due to the need to adapt one into the other, and therefore, they should be considered as evidence for linguistic contact, which is considered in CuCoO as one of the main aspects of cultural contact.

In regard to the methodology, the use of different databases to explore the question of cultural contact in the evidence has raised certain conclusions. In the process of querying and analysis, there have been limitations to the both the use of EDH and ERUB (LOD implemented datasets with a small subset of data about Latin inscriptions from the peninsula), Hesperia (a non-LOD implemented dataset that provides the most complete dataset of Paleohispanic inscriptions) and traditional written sources.

EDH and ERUB provide easy access to the raw data. We have been able to collect, store, enrich and query the data locally to explore different research questions. The fact that EDH provides location data and dating for all the inscriptions helps to map the data both geographically and chronologically and draw comparisons with different sources, always bearing in mind, however, that some of the dates are uncertain and they should be taken cautiously. As EDH includes the linkage with other similar repositories (i.e., Hispania Epigraphica, Trismegistos) and relevant resources (i.e., Pleaides) it allowed the enriching and disambiguation of the information and the exploration of more linked resources.

Nevertheless, on the other side, as with any other datasets, LOD can suffer from certain quality problems mostly related to inconsistency, inaccuracy and incompleteness. The queries run showed that the data retrieved was sufficient enough to make general assumptions about the distribution of Latin inscriptions in Ulterior-Baetica or to retrieve inscriptions with personal names for specific areas or archaeological sites. However, there were important inscriptions missing from the results retrieved and the sample was not sufficient enough to reach certain conclusions. In addition, the data provided did not include linguistic commentaries about the text other than English translation and transcription, commentaries that, on the other hand, are very common in traditional sources. To enrich the results retrieved with this sort of information, it was necessary to rely on traditional corpora of inscriptions which tend to include linguistic commentaries and further bibliography.

Having laid out the issues presented by the data; we should look at what could be the potential causes. The lack of important inscriptions in EDH can be due to several reasons not necessarily related to a problem of incompleteness but to different definitions of scope and impossibility of automatically update the data with other available datasets from which the data was initially integrated (i.e., Hispania Epigraphica). This issue underlines the need for LOD repositories to be very clear about the data collected and the extent to which the data expected is present in the dataset, easily to retrieve and ready to use. Investigations like this case study are also very valuable to underline possible issues with the data that may not be noticed in other circumstances and can be resolved only after the issue has been brought up.

The issue regarding the lack of linguistic commentaries in relation to certain inscriptions is not related to the datasets themselves, but to the standards currently followed in the modelling of epigraphic information. Different ways of recording linguistic commentaries as LOD have been discussed in Chapter 5 with projects like EpiOnt. However, epigraphic LOD still does not provide a standardised way to record aspects like the script, the language or the possible origin of onomastics. An attempt to solve this issue has been made in the inscriptions recorded on sculptures and coin legends in ERUB as we have been able to see in the data retrieved from some of the queries in which variables like `?language` and `?script` where also present in the body of the SPARQL query. However, there is still not a defined standard to model this sort of information and, although certain experimentation is being conducted, there are still not epigraphic datasets able to provide linguistic commentaries integrated as LOD.

Despite such issues, in most of the cases, the queries provided similar results to the conclusions drawn from previous scholarship, regarding the distribution of Latin inscriptions in the province and in those settlements that recorded a more significant occurrence of indigenous onomastica. The use of Hesperia has also shown certain benefits and pitfalls. Whereas the data provided by Hesperia seems to show a major degree of population completeness,[155] the difficulties to access and retrieve the data prevented the querying and processing. It was not possible to collect the data from the dataset to draw further local querying and analysis. In the same way, the geographical coordinates for the inscriptions could not be downloaded, preventing a spatial comparison of the conclusions obtained.

With the aim to keep looking at the potential benefits and pitfalls of LOD-implemented research on linguistic contact in Ulterior-Baetica, the following section explores this question in the evidence provided by the coin legends. In this case, the information has been collected from existing catalogues and integrated as LOD in the ERUB dataset to be interlinked with the already existing data and put in relation to the rest of graphs collected in ERUB (i.e., sculpture, epigraphy and settlements). The following section explores to what extent LOD-implemented research can facilitate the interlinkage, access, querying and retrieval of data to explore the question of cultural contact in the coinage record of the province.

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155 Percentage to which all real-world entities of a particular type are presented in the dataset (Rula et al. 2016).

8.4. Querying and analysis: coinage

The question of whether linguistic contact can be perceived in the coins produced by the mints in the southern area of the peninsula is especially interesting. There seems to be four different behaviours that imply some sort of linguistic contact in the mints. On the one hand, certain mints swap from the vernacular language into Latin shortly after first contacts with Roman groups. This sort of behaviour could be expected after a process of colonisation in which public expressions of collective identity including language tend to adopt the new norm. On the other hand, also the opposite happens in Ulterior-Baetica, where certain mints swap from the Latin used in the first issues to introduce local languages as well, as we shall see in this section. Other phenomena that apply to the language choice in specific coin types include a range of occurrences such as bilingual and mixed texts in both the toponym and the minting authorities.

This subject has been studied in traditional scholarship by the application of traditional research methods like the consultation of numismatic catalogues and relational databases. Whereas it is clear that this sort of research can be developed by traditional methods, it is unclear to what extent LOD can help in providing a systematic way to analyse large quantities of data as well as granting the access to information of difficult access in traditional scenarios. The study of numismatics in early Roman southern Spain by the application of LOD methods has never been done before. In this chapter I explore the possibilities offered by this technology in the systematic querying of epigraphic evidence collected in the coin legends to understand the dynamics of linguistic contact in the coins. LOD and SPARQL in ERUB allows the systematic querying for epigraphic and linguistic features as well as iconographic types displayed on the coins.

The following query retrieves all the information that ERUB collects for the mint of Gades for being the first and the most prolific mint to coin in the peninsula. The query helps the user to see the sort of data that can be retrieved, and the main vocabularies needed in the querying.

Analytical query 4: What are the languages and scripts of the coins minted at Gades?

Answered by requesting the coin types produced Gades ordered by period with language, script and type.

```
# Definition of the prefixes
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX rs: <http://www.researchspace.org/ontology/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX cucoo: <http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>

# Variables required
SELECT ?coin_type ?startDate ?endDate ?obverse_language ?obverse_text
?obverse_script    ?obverse_type    ?reverse_language    ?reverse_text
?reverse_script ?reverse_type

# The subject of the triple is a coin-type issued in the mint of
# Gades with Start Date and End Date.
WHERE {
 ?coin_type a nmo:TypeSeriesItem
  ; nmo:hasMint <http://nomisma.org/id/gades>
  ; nmo:hasStartDate ?startDate
  ; nmo:hasEndDate ?endDate .

#  The  coin  type  defined  above  has  an  obverse,  that  carries  a  text,
# that has a language. It retrieves the text, the script and the type.
  OPTIONAL { ?coin_type nmo:hasObverse/crm:P128_carries/rdfs:member [
    crm:P72_has_language ?obverse_language
   ; nmo:hasLegend ?obverse_text
   ; rs:PX_inscription_script ?obverse_script
   ; cucoo:hasType ?obverse_type
   ]
  }
# second graph to look for the same pattern in the reverses
   OPTIONAL { ?coin_type nmo:hasReverse/crm:P128_carries/rdfs:member
[
    crm:P72_has_language ?reverse_language
   ; nmo:hasLegend ?reverse_text
```

```
    ; rs:PX_inscription_script ?reverse_script
    ; cucoo:hasType ?reverse_type
    ]
  }
}
# Order results by descending Start Date
order by desc (?startDate)
```

Analytical query 4 requests all the coin-types produced by the mint of Gades together with all the information about the text, languages, scripts, type of legend and type of linguistic phenomenon in both the obverse and reverse of the coin-types. Using the coin-type as the main reference, the query first formulates one graph pattern to retrieve dates, language, text and script from the obverses and then, it looks for the same graph pattern in the reverses. The results are then ordered by the dating of the coin-types. The query retrieves a total of 168 entities, a sample of which has been provided in Apendix 2: Analytical query 4. It has been formulated to retrieve all the coin-types produced in the mint of Gades that have some sort of legend, because of this, anepigraphic issues are not provided.

We can see from the data retrieved, in Appendix 2: Analytical query 4, that the first issues with legends (around 3rd century BCE) include Phoeno-Punic letters: 'beth' 'lamed' 'peh' always located on the reverse. These have been understood as possible allusions to the emission of the issue or as value marks. However, after 237 BCE with the Carthaginian arrival, the marks give way to the ancient Phoeno-Punic formulae **mhlm**, **m-p'l** and **m-b'l**. These combinations of consonants have received much attention in recent scholarship. Some consider them as an administrative formula possibly meaning 'made by' or 'issue of' (Perez-Bayer in Alfaro 1991), perhaps some of them repeat the pattern of 'made by the citizens' (García y Bellido 1993, 121). The formulae seem to keep repeating during the 2nd century BCE. Parallel scholarship on this issue, produces similar results regarding the repetition of the formulae and its appearance in the mint of Gadir after the Carthaginian arrival (Estarán Tolosa 2012, 351; García y Bellido 1993, 121).

The value of this query relies on its capacity to retrieve a large amount of data about the mints and the legends in both obverse and reverse in just one single call to the server. This is possible thanks to the modelling carried out in the data using different properties from CIDOC CRM and the ResearchSpace ontology to retrieve the language and text of the coin legends. This sort of modelling and querying is by no means the definite answer, but it provides a workable solution to retrieve linguistic data from the coins. The flexibility offered by the RDF framework and the possibility to use different vocabularies in the modelling allow the queries to be very specific as seen in the following example.

To retrieve further data about these formulae and their potential appearance in other mints, the following query, Analytical query 5, explores the coin-types in ERUB that depict this sort of formulae.

Analytical query 5: What mints present similar administrative formulae? Answered by requesting the mints whose coins include a specified pattern in their legends.

```
# Definition of the prefixes
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX rs: <http://www.researchspace.org/ontology/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX cucoo: <http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>
PREFIX crm: <http://erlangen-crm.org/current/>

# Variables required
SELECT   ?mint   ?reverse_language   ?reverse_script   ?reverse_text
?reverse_type

# The subject of the triple is a coin-type issued in a mint and that
# mint has a reverse which carries a text with a language and a
# script.
```

```
WHERE {
 ?coin_type a nmo:TypeSeriesItem ;
 nmo:hasMint ?mint;
 nmo:hasReverse/crm:P128_carries/rdfs:member [
    crm:P72_has_language ?reverse_language
   ; nmo:hasLegend ?reverse_text
   ; rs:PX_inscription_script ?reverse_script
   ; cucoo:hasType ?reverse_type
   ]
# Filter with a regular expression to retrieve the coin types with a
# reverse text that contains a combination of possible consonants.
 FILTER regex(str(?reverse_text), "(b[`']?b|mp)[`']?l", "i")
}
```

It seems that the formulae are only present on the reverses, so the query requests language, text, script and type for all the reverses of the mints collected in ERUB that comply with specific conditions. Using a FILTER, and a regular expression the query retrieves mints with coin-types that match with a legend that contains a possible combination of the different formulae. As we do not know exactly what kind of formulae we are looking for, the filter just asks for those that contain any variation of the group of consonants that seem to be repeated in these formulae ‘bbl’ ‘b-b’l’ ‘b'b'l’, ‘mpl’, ‘mp'l’, ‘mp`l’. The query provides a result of 52 coin-types that have a reverse legend containing those consonants visualised in Appendix 2: Analytical query 5. The phenomenon seems to be present in 4 different mints: Asido, Gades, Sexs and Tagilit and each of the mints seems to present different combinations of the formula, as sumarised in table 8.7.

mint	**reverse_text**	**reverse_type**
nm:asido	sdnb'l/'sdn/ s(b) b' l' / b'b'l	Toponym + Ethnonym
nm:gades	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	crescent / aleph / mp`l `gdr	Topoym + Admin. Formula
nm:sexsi	mp'l / sks	Toponym + Admin. Formula
nm:tagilit	mp'l	Admin. Formula

Table 8.7. Summary of mints with Punic administrative formulae and text provided.

To evaluate whether the query provided valid results, I am going to look at recent scholarship on the question of Punic formulae in Ulterior-Baetica issues. On this topic, Estarán Tolosa (2012) underlines the progressive introduction of this formulae from Gades to rest of mints. According to her, the formula (**mp`l / `gdr**) was first adoped by Gades and then by Sexs and Tagilit. Folowing this same pattern, other mints also introduced the formula (**b'b' l**) including Asido (**b' l)** but also Oba (**b'b' l), / b'b'l)** Bailo (**b'l / 'bln)** and Nabrisa (**n(l) 'b).** As we can see from the sumary provided in 8.7. The query retrieved results for Asido, Gades, Sexs and Tagilit, however, it did not provide results for Oba, Bailo and Nabrisa. As we encountered this problem, we tried to query the dataset for the obverse and reverse legends of these mints. These Queries retrieved the results expected, as seen in Table 8.8.

Mint	Reverse_ text1	Language1	Reverse_ type1	Reverse_ text2	Language 2	Reverse_ type2
nm:bailo	b'l 'bln	neo-punic	Toponym + Ethnonym	BAILO	Toponym	Toponym
nm:oba	OBA	Latin	Toponym	b'-b'l	Punic	Admin Formula
nm:nabrisa	NA. BRISSA	Latin	Admin Formula + Toponym			
nm:nabrisa	n(l) 'b	Punic	Punic			

Table 8.8. ERUB data for the mints not provided in Analytical query 5.

The interesting fact here is that the data for these three mints was not provided by the initial query. This was due to different reasons for each of the mints. In the first case, for the mints of Oba and Nabrisa, the data was not provided because these mints record two different texts in the reverse and the Punic legend appears in the second text. Analytical query 5 retrieved those mints that had any combination of the given consonants in the main text of the reverses and therefore it did not look into the secondary text. In the case of Bailo, the mint is not retrieved because the legend has a combination of consonants that includes an ‘n’ which was not recorded in the regular expression used in the initial query. The issues presented here speak to the limitations of exploring research questions in SPARQL. Since we did not know the total number of coin-types with this sort of legends or whether the mints had more than one text in the reverse, an exploratory query was used to retrieve as much as possible, but the query was not completely successful. It was necessary to rely on written sources, to check on the reliability of the results. This again speaks to what extent LOD querying in this case needed for confirmation from previous scholarship to support research conclusions.

According to Orozco (2209) while the insertion of these formulae seems to be common in the Punic mints of the Mediterranean, what is not so common is the inclusion of toponyms. This is ratified is the results retrieved by Analytical query 5 that show how some of the formulae have been identified as toponyms (i.e., Gades, Asido and Sexi). In the case of Cádiz, some of the reverses include the formulae mentioned above and the letters **‘gdr**. As far as we know, Semitic scripts tend to ignore the writing of vowels, so ‘-g-d-r’ has been considered the Punic toponym for the city of Gadir (Cádiz) (Orozco 2009, 254). If this were the case, the combination of the toponym with the formulae mentioned above could express something like ‘made by the citizens of Gadir’, a pattern that could be repeated in other mints of Punic influence (i.e., Asido and Sexsi).

The same situation occurs in other cities of Punic influence in Sicily such as Panoromo, Moty or Salunto. These places produced coins with metrology and typologies adapted to the Greek system imposed on the island, and although some of them do include Punic legend, these inscriptions do not allude to the name of the towns (Chaves Tristán 2009, 322). As Chaves Tristán (2009, 322) has argued, the inclusion of the urban toponym **'gdr** may have marked a strong difference between the city of Gadir and the patterns followed by the rest of the cities controlled by Carthage. Even, the mint of Carthage always produced anepigraphic coins that only in some cases included single letters never related to the name of the city (Alfaro 1991, 111-115).

The introduction of bilingual legends on the coins of the southern mints took place in the transition from the 2nd to the 1st century BCE. As it was explained earlier in this section, bilingualism is a complex phenomenon that implies a varied range of processes and can manifest in different ways. In order to explore bilingualism and more widely, linguistic contact in the coin types in ERUB it will be necessary to first see what kind of phenomena can be appreciated in the different legends and mints. The following query explores any sort of coin that displays a different language and/or script on the obverse and reverse.

Analytical query 6: What mints produced coins with any sort of linguistic variation? Answered by requesting coin types that present a mismatch between the languages on the obverse and the reverse.

```
# Definition of the prefixes
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX rs: <http://www.researchspace.org/ontology/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

# Variables required
```

```
SELECT DISTINCT ?coin_type ?name ?obv_text ?obv_lang ?rev_text
?rev_lang
FROM <http://data.open.ac.uk/context/erub/coinage>

# The subject of the triple is a coin-type with a label, that
# coin-type has an obverse that carries a text written in a
# language.
# the coin-type also has a reverse that carries a text written in a
# language.
WHERE {
?coin_type a nmo:TypeSeriesItem ;
        rdfs:label ?name ;
        nmo:hasObverse/crm:P128_carries/rdfs:member [
      crm:P72_has_language ?olang ;
      nmo:hasLegend ?obv_text
] ;
      nmo:hasReverse/crm:P128_carries/rdfs:member [
      crm:P72_has_language ?rlang ;
      nmo:hasLegend ?rev_text ]

#The languages on the obverse and the reverse must be different
FILTER( ?olang != ?rlang )
. ?olang rdfs:label ?obv_lang
. ?rlang rdfs:label ?rev_lang
}
```

Analytical query 6 could be considered the most interesting query of chapter 8. The query formulates one graph pattern to retrieve data for the obverse, followed by one graph pattern to retrieve data for the reverse of the coins, and then it filters by those that present a mismatch between the language on the obverse and the language on the reverse, the most basic way to diagnose linguistic variation. The query retrieves 52 coin-types with some sort of linguistic variation between the obverse and the reverse as visualised in Appendix 2: Analytical query 6.

In general terms, the results obtained are similar to those drawn from previous scholarship. The data retrieved shows that Latin is the language present in all the coins with bilingual legends, so there is no combination between indigenous languages themselves or between other colonial languages such as Greek or Punic. From the query, the combination of languages in the coin legends seems to be: Latin/southern Iberian, Latin/Iberian, Latin/Punic, Latin/Turdetanian? or Latin/Neo-Punic as visualised in Fig.8. 10.

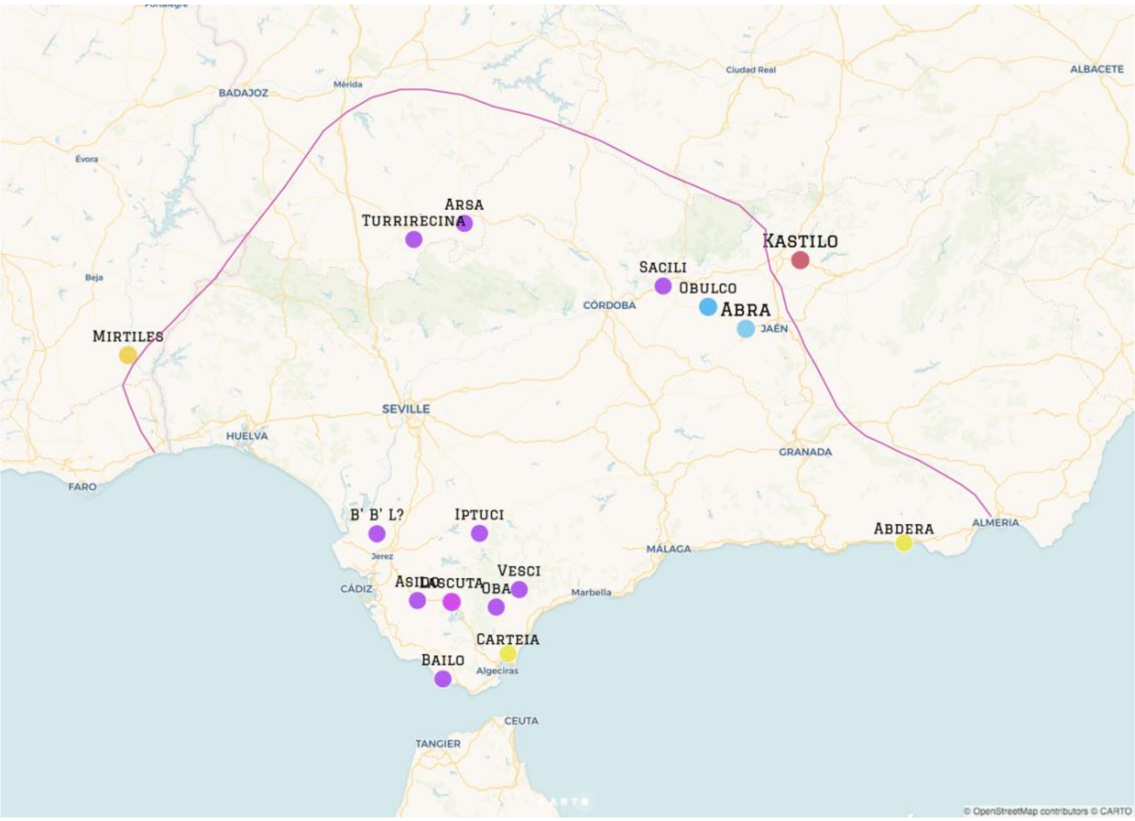

Fig. 8.10. Mints with bilingual legends according to ERUB within the limits of Baetica: Latin/Punic (yellow), Latin/Turdetanian or Latin/neo-Punic (purple), Latin/Iberian (red), Latin/ southern-Iberian (blue).

The yellow mints are the ones that combine Punic and Latin scripts. The results retrieved show that one coin-type from Abdera (Adra, Almería), combines the Latin authority 'CAESAR DIVI AUSGUSTUS' with the neo-Punic toponym '´bdrt'. The archaeological record of Abdera documents an early Phoenician presence from the 7th century BCE. The Punic toponym seems to remain until the Tiberian period after which the mint ceases its activity. Regarding the iconography, the first emissions are typically Phoenician with Herakles-Melqart, tuna fishes and dolphins. There is also the representation of a laureated woman that has been interpreted as Tannit, protector of the city (García-Bellido/Cruces Blázquez 2001, 16).

In the case of Mirtiles (Mértola, Portugal) the query retrieves a set of coin-types that combine the Latin toponym 'MVRT or MVRTIL' with a Latin transcription of the Punic 'authority' 'L. A.P DEC. Q.' Finally, in the case of Carteia (San Roque) the query retrieves a set of issues with some initials in the obverse that have been considered of Punic Origin, this agrees with Garcia y Bellido and Cruces Blázquez (2001 b, 88). According to the scholars, the issues from Carteia present a series of peculiar initials perhaps related to the authorities but lacking personal names, which have a difficult transcription intro Latin. This could be a possible indication of a Latinisation of Punic administrative formulae.

Kastilo, Obulco and Abra minted coins with legends that combine Iberian/Latin or southern-Iberian/Latin. For the mint of Kastilo/Castulo (Linares, Jaén), the query retrieves three coin-types that combine the Latin formula 'VOC·ST(·F)·N' with the southern-Iberian toponym 'Ka.s.ti.l.o.' and two coin-types that combine formulae of Iberian origen 'M. ISC / C. AEL' and 'M. BAL. F.' with the Latin intials 'M. FVL.' and 'M. Q. F.' respectively. According to Estarán Tolosa (2019, 97), the mint of Kastilo should be considered within the mints with Ibero-Latin legends but clearly differentiated from the mints of Obulco and Abra. The mint started working in the Punic period, second half of the 3rd century BCE, with the toponym in Southern Iberian characters kastilo. From the 2nd century BCE certain symbols considered as possible value marks were introduced, most of them in Southern-Iberian script but also two of them in Latin. From the 1st century BCE, the first variation in the authorities occurs with the introduction of Latin names registered with *duo nomina* and filiation) Cn(aeus) / Voc(onius?) · St(---?) · f(ilius) but it also includes what seem to be Latinsed Iberian names (Sacaliscer y Soced(..) and the Latinsed Toponym Cast(ulo?) (Estarán 2014, 94). There is still not much information about what was the exact function of the minting authority in this context. The desire to record the name of the authority in Latin has been put in relation to the role of the Italic families in the minting. Nevertheless, the possible Iberian origin of some of the names could indicate also an Iberian origin of the magistrates.

This linguistic choice is similar the one seen in Obulco (Porcuna, Jaén), where the query retrieved 13 coin-types that combine the Latin toponym, 'OBULCO' with different southern-Iberian variants for the authorities 's.i.bi.bo.l.a.i.', i.l.ti.ŕ.a.t.i.n k.o.l.o.n.' and 'bo.ti.l.ko.ś / G21a-ko.e.ki'. Obulco has been considered the first mint to produce coins in the southern area of Ulterior Baetica together with Kastilo (Linares, Jaén) (Chaves Tristán 2000, 122-123) and it is very unusual because of the early introduction of Latin. The first issues of the mint include only Latin legends even before the introduction of the Southern Iberian script. This phenomenon has been related to the presence of Italic families in the area who would have incentivised the production of local coin (Chaves 1999, 312-315). The mint did not produce purely southern-Iberian legends, but only bilingual versions in Iberian and Latin or purely Latin legends. The only strictly bilingual legend is that of the first emission that includes the name of the mint in Iberian and Latin. Apart from that, there are also several coins with mixed legends which include the name of the city in Latin alphabet on the obverse and the names of pairs of magistrates in

Southern-Iberian on the reverse considered in some cases as Turdetanian onomastica (Estarán 2014, 109).

In the case of Abra, (Torredonjimeno?, Jaén) the legends combine the Latin toponym, 'ABRA' with the southern-Iberian authorities 'u.e.ko.e.ki / k.i.o.n.is'. These names have not yet been deciphered. The influence of Obulco in Abra is clear, both in the iconography (a female deity with the hair in a bun) as in the epigraphy where again Latin is chosen for the toponym and Iberian for the magistracies. The metrology is Punic- Turdetaninan, in contrast with the epigraphy and the iconography, which receive more influence from the Iberian tradition.

Within the combination of Latin and Turdetanian/Neo-Punic, previous scholarship (Herrera Rando 2019, Jiménez 2014, Sola Solé 1980) differentiates the group of the so-called Lybiophoenician mints which includes the mints of Arsa, Asido, Hasta Regia, Bailo, Iptuci, Turris, Lascuta, Oba, Sacili and Vesci.[156] They were firstly named in the 19th century by Zóbel de Zangróniz. The scholar identified a new and still not deciphered alphabet used in a set of mints located mostly in the hinterland of Gades that minted coins from the second half of the 2nd and the first half of the 1st century BCE. This still non-deciphered script has been called Lybiophoenician, but it is believed to record Turdetanian and neo-Punic texts. Most of the coins present the particularity of being bilingual, recording what has been traditionally identified as the same word in two different languages. With the aim of identifying the coins and the communities who made them, Zobel associated them with the Lybiophoenicians, an ethnic group mentioned in

[156] There is certain controversy, however, among two of the mints. Jiménez (2014, 225) does not consider Sacili as one of them, whereas García Bellido/Cruces Blázquez (2001b, 156) consider Hasta Regia as one of the types of the series from Gades and not a mint in itself.

the ancient sources that had not been yet properly identified (e.g., Pseudo-Scymnus of Chios, *Periegesis* 196-201).

The coins combine legends in Latin and another language still to be deciphered. Sola Solé (1980) made an attempt to identify the alphabet used by this group of mints as a variation of Neo-Punic which combined archaic and modern features. Based on this possible identification, Jiménez (2014) considered the mints within the sphere of the Punic Mediterranean and studied them within the context of the Punic control over the Iberian Peninsula, an especially interesting approach since it seems the mints started working around the fall of Carthage in 146 BCE making the assertion of Punic identity of special significance. Today, Sola Solé's theory seems to be mostly rejected by Spanish scholars, however, the Punic influence displayed by the mints is undeniable especially in features such as iconography and the metrology of the coins. Although the denomination of the mints/coins is still used, it is under debate whether they should keep this nomenclature or exchange it for a more appropriate one.

As explained before, most of the mints in the Lybiophoenician group produce coins with bilingual toponyms in Latin and Lybiophoenician identified in some cases as Turdetanian (see for example the interpretation of Estarán 2014). Estarán (2014) classifies the legends as bilingual inscriptions of type 1, therefore 'Epigraphs composed by 2 enunciations of equivalent content written in 2 languages.' Lybiophoenician coins seem to display purely bilingual inscriptions except for Hasta Regia which minted coins with the administrative formula **b'b'l** only recorded in Neo-Punic according to García y Bellido and Cruces Blázquez (2001, 156), because of this, it has not been retrieved by Analytical query 6.

The Lybiophoenician mints produce coins around the second century BCE and have been mostly located in the provinces of Gades and Badajoz —not all of them would therefore be situated in the hinterland of Gades as was initially thought —as seen in Fig. 8.11.

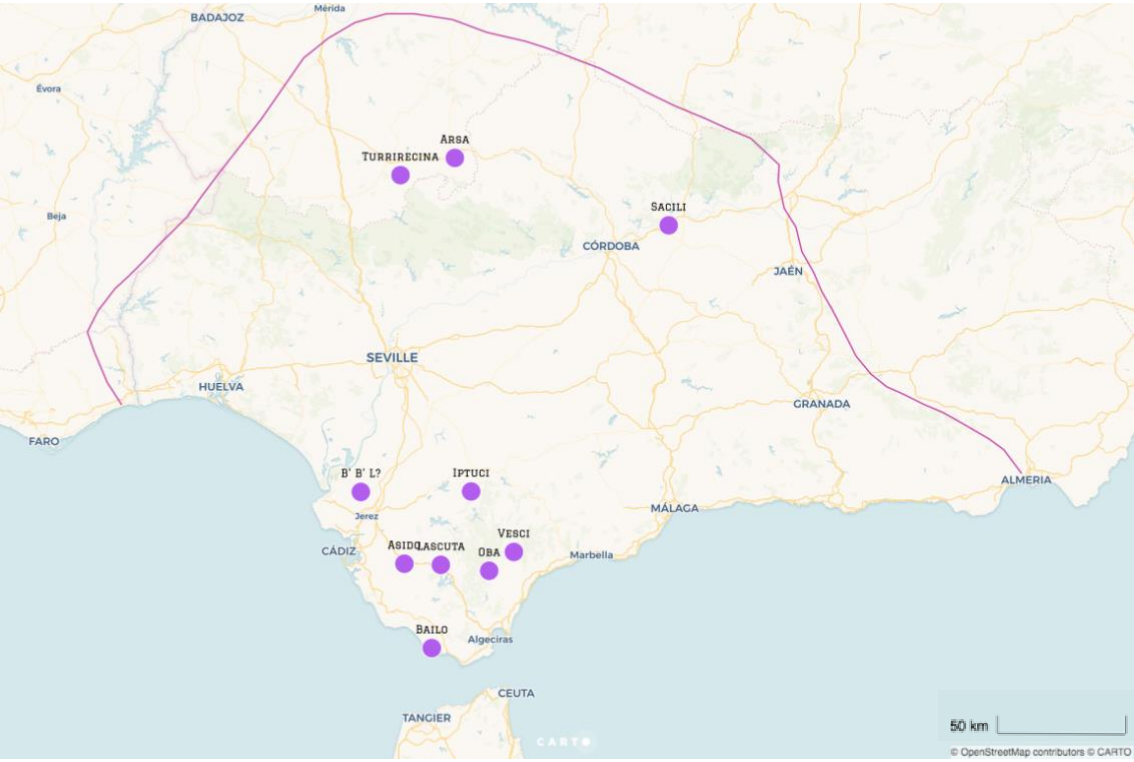

Fig. 8.11. Lybiophoenician mints within the limits of Baetica.

Together with the toponym, another aspect of interest is the authority that appears in some of the coins. In the case of Lascuta for example, the legend in the coins of the third series displays the name ‘P.TERENT BODO’ in the obverse and ‘NVMIT BODO’ in the reverse. These have been considered the names of the magistrates or local authorities that either subsidised or authorised the coins. Estarán Tolosa (2014) considers them as Iberian, possibly Turdetanian names written in Latin. García-Bellido and Cruces Blázquez (2001) underline the possible word ‘BODO’ repeated in both titles as the name of a Punic magistracy somehow related to the minting process. Other names that appear in the mint are GISCO (2nd series) also considered as Punic by García-Bellido and Cruces Blázquez (2001) and IRTHI (2nd series) considered as a transcription of an indigenous name. In this way, here we find the same pattern as seen before in the epigraphy where ‘Punic’ or possibly ‘Turdetanian’ names were Latinised but displayed together with elements of strong non-Roman influence.

The introduction of Latin in the mints seems to be progressive, going from bilingual legends in most of the cases to the use of only Latin for the toponyms in the last series. What is interesting apart from introducing a language which has not yet been completely deciphered, is that they display an interesting entanglement of cultural traditions which can be perceived not just in the language of the legends but also in the metrology and the iconography chosen to be depicted. One of the benefits of LOD is the flexibility that RDF allows in terms of data modelling. In contrast to relational databases that tended to have more rigid schemas to model only one specific type of domain (e.g., epigraphy, iconography etc.), the combination of different vocabularies allows the easy modelling of data from different domains without the need to change the nature of the database. In this case, ERUB allows the collection of data about the legends on the coins, but also the iconography and the metrology of the issues. The metrology patterns that seems to repeat in the Lybiophoenician mints according to ERUB are Punic-Turdetanian, Phoenician-Turdetanian, Punic and Lybiophoenician. These results agree with García-Bellido and Cruces Blázquez (2001a) that considered the coins to depict a Punic-Turdetanian pattern for the weights with the unit around 8/9 gr. Applying SPARQL querying, this sort of metrology can also be compared to the iconography depicted in this set of coins, since the modelling of ERUB allows the querying for iconographic patterns on obverses and reverses. The following table (8.9.) displays the analysis of the most common iconographic pattern in each of the mints.

Mint	ObverseDescription	ReverseDescription
Arsa	male head with big eye	ear
Asido	baal-amon with beard and wreath	bull jumping with star
Asido	bull with star	dolphin with crescent
Asido	male head (melqart) with lion skin and club	cornucopia and vegetable wreath laurea?
Asta (Hasta Regia)	frontal malle head (melqart) with lion skin	two tuna right or left
Bailo	bull with star and crescent	ear left
Bailo	herakles melqart head with lion skin and ear left	bull left
Iptuci	male head with beard and hairdband baal-hammon?	wheel with eight ratios and inner circle
Iptuci	melqart head with lion skin right	wheel with eight ratios and inner circle
Lascuta	hercules-melqart head left with lion skin and club on the shoulder	stepped altar with four palms
Lascuta	female head with helmet right	elephant right
Oba	female head left and palm	gallop horse left
Sacili	wreathed male head right with scepter	horse galloping right with scepter in the ground
Sacili	elephant marching right	horse marching right with scepter
Turirecina	female head laureate with ivy wreath, tannit?	falcata style knife
Vesci	male head naked right and spear baal-hammon?	bull left and tree

Table. 8.9. Most common iconographic patterns in Lybiophoenician mints.

The table above shows a strong presence of symbols such as crescents and stars which have been related to Punic gods. There are also several animals such as dolphins, tuna and bulls which could be more related to the fauna of the place or the typical industries of the area. The possibility to interpret the iconographic discourse on coins as a narrative constituted by the images on both the obverse and the reverse could explain the allusion to certain gods (on the obverse) in conjunction with the animals (on the reverse) as a unique unit. In this way, the bull could be interpreted as a manifestation of Baal Hammon and the dolphin, which normally appears together with crescents, could be understood as an allusion of Tannit, normally found in *steleae* and coins in association with the goddess (García y Bellido 1985-6, 509). Male heads are also very frequent on the obverse normally related with Herakles-Melqart (Asido, Asta, Bailo, Iptuci) and in some cases to

Baal-Hamoon (Asido, Vesci, Iptuci) or in the case of women heads with Tannit (Turirecina).

Another interesting motif is the representation of an elephant on the reverse of certain coins, which has been understood as the symbol of Africa (García-Bellido/Cruces Blázquez 2001, 265). Elephants appear on the reverses of coins from Turrirecina, Sacili and Lascuta with special importance in the last one where it is recorded in three different types. The appearance of the elephant has motivated the identification of the communities with Punic or Numidian origins which could also explain the Neo-Punic characters in the legends. In any case, the iconography of the coins displays a significant presence of Punic motifs that has to be seen in combination with the choices made in the metrology (Punic, Turdetanian and Roman) and the bilingualism of the legends that not only introduces Latin together with a perhaps Turdetanian toponym but that also displays examples of Latinisation of either Punic or indigenous onomastica.

In regard to the evaluation of the method, in technical terms, Analytical query 6 retrieved a set of bilingual mints that agrees with the latest scholarship on bilingualism in the coinage of southern-Iberia (mainly Estarán Tolosa 2014; Herrera Rando 2019). Leaving aside the linguistic analysis of the legends and the possible reasons for the different combination of languages, which is further looked at in Estarán Tolosa (2014) and Herrera Rando (2019), the implementation of the CuCoO Ontology and SPARQL querying allowed for the query to retrieve the main set of bilingual mints from southern early Roman Spain. These results prove that the methodology is an efficient approach and has potential benefits regarding future research in terms of saving time and effort to find linguistic phenomena such as bilingualism in the epigraphic evidence. The experiments carried out in this chapter relied on a very preliminary modelling of the data that, although designed ad hoc for this purpose, demonstrated that is possible to retrieve accurate data for specific research questions. Future developments carried out in the modelling of epigraphic data will make it possible to design more complex queries, perhaps not only looking at bilingualism but at other phenomena of code-switching and mixed texts.

Regarding the quality of the data provided, the results of the queries demonstrated that in some of the cases, the epigraphic evidence collected in ERUB was not reliable enough to reach research conclusions without previous confirmation with other sources of knowledge. In a series of cases, important inscriptions were missing, and the population completeness of the dataset was not good enough. To overcome this issue, it was necessary to rely on other sources of knowledge which confirmed that the results retrieved were known to be correct. This issue does not invalidate the utility of the methodology but emphasises the importance of completeness in LOD.

8.5. Conclusions

This chapter has focused on the question of linguistic contact in the ERUB data through SPARQL querying. It is the first time that a systematic exploration has been done through direct SPARQL querying in a linked dataset that collects the inscriptions of Baetica as well as coinage and sculptures. This has been done in order to explore linguistic contact in two specific phenomena: the Latinisation of the onomastics and the different phenomena of linguistic contact in the coin legends.

Regarding the Latinisation of the onomastics, the queries run in this chapter have demonstrated how cultural contact can be perceived in the onomastic record of the province of Ulterior-Baetica between the 4th century BCE and the 1st century CE through LOD resources. The inscriptions analysed display a strong non-Roman presence in the onomastics of a late chronology (as provided by the dating included in *EDH* data). Furthermore, the names that can be considered of a non-Latin origin display different influences which have been classified as Greek, Iberian, Punic, Turdetanian or even Etruscan, showing the complex entanglement of cultural influences in the area.

The Punic presence in the area especially in settlements such as Ituci Virtus Iulia (Torreparedones), where at least one of the names seems to have clear Punic influences, as well as the strong presence of Punic and neo-Punic languages in the coinage, could relate to the impact that Phoenician and Punic communities had on the expansion of epigraphic culture in the southern area. The significant presence of a previous non-epigraphic Phoenician culture in the province still ongoing in the last centuries of the Republic could explain the fact that the epigraphic habit was so uncommon in the province before Roman conquest and increased significantly in the Augustan period. The habit of writing on stone was not so developed in the area during the Phoenician and Punic presence, perhaps because other more perishable materials were used instead of stone or simply the epigraphic habit was simply not as extended.

Regarding the linguistic phenomena displayed in the numismatic evidence, the analysis shows that the mints of Ulterior-Baetica used four different languages to record the names of their cities and the authorities involved in the minting process; Phoeno-Punic that later evolves in Neo-Punic, southern Iberian and Southern script, a possible presence of

Turdetanian recorded in Lybiophoenician script and Latin. The Phoeno-Punic language was first used by the mints located in the hinterland of Gadir/Gades and seems to have been prominent in the area with the oldest version found in the Phoenician legends of Gades.

Lybiophoenician mints used a non-completely deciphered script called Lybiophoenician to record what has been identified as Turdetanian language in their legends. These coins combine a huge range of cultural influences not just in the choice of legends choice but also in the metrology and the iconography with its strong Punic influence in an area that was not entirely considered as Punic before and goes far from the hinterland of Gades. The dissemination of mints with clear Phoeno-Punic inspirations indicates a wide distribution of Punic influence in Ulterior-Baetica that diminishes, however, in the Guadalquivir Valley, the area were mints of Roman influence such as Italica and Romula seem to flourish. After Latin, Punic and Neo-Punic are the most prominent languages used by the mints followed by the Southern Iberian script.

Having done a range of queries on the ERUB database, I can conclude that the different types of linguistic contact amongst the communities were: 1) Latinisation of toponym without a clear effect on metrology or the iconography 2) the recording of the toponym in two different languages implying the desire two reach two different audiences 3) adaptation of one language into another to record the names of individuals or, in some cases, possible indigenous magistracies involved in the minting process, for which we still do not have enough information to develop significant conclusions.

The strong presence of cities that used the Punic or neo-Punic script in their legends testifies that traditional perceptions of the Roman colonisation of the area were wrong to leave aside the Phoeno-Punic component in the area. On this topic, Machuca Prieto (2018, 132) has argued that after nine centuries of continued presence, Phoenician communities should no longer be considered as foreigners by the time the Romans arrive in Ulterior-Baetica since such a division is not reflected by classical authors, nor in the archaeological or numismatic evidence. These communities shared origins and important cultural traits such as language and religion as a sort of Punic cultural *koine* that remained in the area time after the 3rd century BCE. This, however, does not mean that all communities shared a Punic ethnic cohesion. On the contrary, there are different interpretations of the Punic element both in the different variations of the languages recorded in the legends of the coins as well as the different iconographies chosen to depict deities and motifs that point in other direction as we shall see in the following chapter.

This chapter has applied LOD technologies to explore linguistic contact in early Roman Ulterior-Baetica. Having tested the method on an archaeological database developed ad-hoc for this purpose, certain conclusions have been reached. In the first place, the state of the art in LOD repositories for epigraphic research is relatively in good shape but there is room for improvement. Although there have been previous attempts to produce an ontology for epigraphic data, the objective has not yet been achieved. The consequences of this can be perceived in the modelling of the epigraphic RDF available in resources like EDH where important features of the inscriptions such as language or script are not still individually recorded in the data allowing very little capacity for the SPARQL querying. In addition to this, the availability of epigraphic evidence for the Iberian Peninsula as LOD is still not ideal. Although projects like EDH have made available a more than significant number of Roman inscriptions from Spain, there is still a large amount of epigraphic evidence specially related to Paleohispanic languages that is not available yet as open access processable information. *EDH* is not a complete resource and several inscriptions have not been included yet, especially those of recent discovery; furthermore, apart from *EDH* there are no other databases that make available epigraphic data from the Iberian Peninsula in LOD standards. This has made it very difficult to find alternative sources of inscriptions. In this sense, I have queried the *Hesperia* database whose results have also been explored in this chapter combined with inscriptions from traditional sources. The results retrieved from Hesperia, although more complete and better referenced, were difficult to process and analyse with the rest of the data due to the access and processibility difficulties presented by the dataset. The implementation of these resources with LOD would have enriched the queries and the results. Nevertheless, due to time and space constraints, the effort and time required for such endeavour were not affordable in this case. The amount of work invested in the integration of written catalogues as LOD in the case of the coinage and the sculpture made it not possible to extend the project to the integration of epigraphic data. This is an important conclusion in terms of evaluating the amount of time and resources required to construct a complete and operable LOD resource.

The main benefits of LOD-implemented research observed in this case study included flexibility in RDF modelling, freely accessible data, processable data, and interlink-able and disambiguated information. Nevertheless, due to the ad-hoc nature of ERUB and the incompleteness of the data, the results obtained were not reliable enough for definite conclusions. The main problems that arose were related to the incompleteness of the datasets that made it necessary to rely on other sources of knowledge for confirmation.

The use of SPARQL querying for analytical purposes has also provided interesting insights in the method. Although the dataset was incomplete, the results of the querying were a complete examination of the data. Testing the results against previous scholarship enabled me to refine the queries, which was still possible within the data structure. The queries formulated retrieved correct results in all the cases as confirmed by the sources discussed and proved the efficiency of the approach in terms of quick retrieval of complex linguistic phenomena.

In the last section of this chapter, we have seen how the images depicted in the coins can help to support certain hypothesis regarding cultural interaction between communities. In this sense, the following chapter explores to what extent LOD-implemented research can help in understanding cultural contact in the visual culture of early Roman Spain.

Chapter 9: Cultural contact in the visual arts

Overview

Chapter 8 applied LOD technologies to explore the epigraphic record of the province of Ulterior-Baetica through SPARQL querying on the ERUB dataset with regard to two research questions: 'how is cultural contact manifested in the onomastic record?' and 'how can cultural contact be perceived in the coin legends?' The analysis showed that the onomastic record of ERUB does display a strong indigenous presence until the Republican period with onomastic formulae of different origins including Greek, Punic, Etruscan, Iberian and possibly Turdetanian. The lack of wider indigenous epigraphic evidence in the area has been related to the anepigraphic nature of Phoenician culture. This hypothesis is supported by the strong Phoeno-Punic influence identified in the coin legends that display very different cultural contact phenomena including bilingual and mixed texts. Moving away from the epigraphic analysis, Chapter 9 focuses on the visual record of the province and explores the question of cultural contact in the images depicted in the material culture collected in ERUB. It expands upon the concept of iconographic contact and explores the utility of LOD-implemented research to explore cultural interaction dynamics in the visual record.

9.1. Iconographic contact

As Gell (1988) demonstrated, it is possible to trace cultural influences in the visual record of a community by identifying different patterns passed from one group to another. Together with the language recorded in sculptures, inscriptions and coin legends, the material record of a community may display a series of images or iconographic types which can provide information about the community itself and its relations with other groups in a situation of cultural interaction.

Keith Hart (2005, 1) argued that communities operate through common culture and meaning, and that money is, together with language, ‘the most important vehicle for this collective sharing’. Following this rationale, one may argue that iconographic types on the coins minted in Ulterior-Baetica were not randomly chosen. The study of iconography and iconology in Hispania is a well-established discipline (see Chaves Tristán/Marin Ceballos 1992; Moreno Pulido 2007; Chaves Tristán 2008; 2009; Mora Serrano 2019; 2013; 2007). Traditional discourses on the iconography displayed in coinage tended to focus on the authority in charge of the minting and the image to be displayed. Current works also emphasise the role of the receptors of the money and whether they were able to understand the iconographic discourse depicted (Chaves Tristan 2008; Moreno Pulido 2016). Either way, the choice of certain images over others responded to a desire for self-identification if not of the whole city, at least of the groups in charge of minting that series.

Indeed, images are a very powerful tool to demonstrate cultural contact between different communities since iconographic types can be copied and adapted from one group to another, although emulation does not essentially mean the attribution of the same meaning to the adopted image in the recipient culture. The act of reproducing the iconographic discourse or pattern does, however, necessarily imply some sort of communication between groups and the extension of an image over a territory does demonstrate its adoption by local communities. Inscriptions can link such an image to a specific community or cultural sphere and, especially in the case of coins, the toponyms recorded in the legends allow one to roughly establish the geographical extent of this form of cultural contact.

The repetition of certain iconographic patterns in the peninsula has long been related with ethnic identity and the manifestation of collective representation embedded within the choices of certain symbols over others. In this respect, Mora Serrano (2007; 2012) is especially significant. His work emphasises the conscious use of coinage by civic authorities to reaffirm cultural identity and political autonomy (Mora Serrano 2007, 423) and focuses on the imagery of coins as a reflection of religiosity and collective identity. The author underlines the role that religiosity played in the choice of the iconographic discourse of coinage to explain the continuity of Phoenician imagery in the towns of Ulterior-Baetica even after the Roman conquest.

The province of Ulterior-Baetica from the 4th century BCE to the 1st century CE is an interesting laboratory to explore the cultural interaction in the visual record of the communities that inhabited this space and recorded different sorts of iconographies in the coinage and the sculptural record. In this chapter, I shall analyse the adoption and execution of the different types either produced in the peninsula or imported from the Mediterranean to explore the visual record of ERUB and to understand the convergence of different cultural influences as a means of communication. I aim to explore the benefits and pitfalls that LOD-implemented research can have in the analysis and understanding of cultural interaction in the visual record of the province.

9.2. The procedure

As with the previous chapter, the methodology chosen to explore iconographic contact in early Roman Spain is LOD-implemented research based on the data integrated as an LOD dataset (ERUB) implemented with the CuCoO ontology and with querying and analysis performed through the SPARQL language. ERUB is the first dataset to make available the numismatic corpora of coin types from the Iberian Peninsula as RDF. It is the first resource where different coin legends and iconography can be retrieved in a systematic way by querying the dataset. All previous research on this topic has been developed using traditional methods of research focused on written sources and the archaeological evidence. Because of this, it would not be possible to evaluate the results with similar research unless a great deal of resources were to be spent in data extraction and re-engineering. Nevertheless, specific conclusions obtained from the data such as the prominence of certain images will be evaluated by comparing them with available scholarship on the topic.

In this chapter, I aim to run a series of SPARQL queries to explore the extent to which LOD-implemented research can be a useful method to explore research questions related to the spread of certain images in the visual record of the province. The aim of the chapter is to assess the extent to which the potential benefits of LOD stated earlier in this thesis (flexibility in data modelling, easier access to the information, interoperability between repositories and easier analysis and processing of the information with SPARQL querying) can provide efficient results in the analysis of iconographic contact in early Roman Spain.

The first examples of SPARQL querying for numismatic research were attributed to Sebastian Heath (2018). The scholar used SPARQL querying on *Nomisma* to approach the question of the circulation of coins in Republican Italy and Google Fusion Tables and Gephi[157] to visualise the results. This chapter takes a similar approach towards the spread of iconographic types both in the coinage and sculpture record of Ulterior-Baetica. The application of LOD technologies allows us to enrich the information of ERUB with data from *Nomisma*, *Arachne* and *Pleiades*. In this chapter, SPARQL allows us to run queries across different repositories as well as querying required and optional graph patterns.

9.3. Querying and analysis: iconographic patterns

LOD and ERUB enable querying for specific iconographic patterns. However, it is important to emphasise that there are two different ways to understand iconographic similarity: a) the repetition of iconographic themes as for example Herakles-Melqart or the corn ear or b) the similarities displayed by the style in which two coins with the same theme are manufactured; for example, when the coins from two different mints represent exactly the same image of a woman head with a specific hairstyle. Only the first sort of iconographic contact will be explored in this section since this type of relationship can be directly inferred from the repetition of themes and images in the results retrieved by the SPARQL queries. This exploration will allow one to further understand the iconographic contact between the different mints including the themes most profusely copied in the province.

[157] Gephi is an open-source visualisation and exploration software for Social Network Analysis available at: https://gephi.org/ (accessed August 2020).

To explore iconographic types on the coins, the following query requests the iconography of the obverses and reverses of coins of each mint and orders them based on the number of occurrences of each iconographic type per mint. Hence, we can see what the most repeated iconographic types are. Furthermore, it orders the result by mint name in ascending order, then in descending order by number of iconographic types, so as to first show the most frequently repeated ones per mint. The results are displayed in Appendix 2:Analytical query 7 in a table that shows only the most numerous types in each case together with a chronological reference for the minting activity.

Analytical query 7a: What are the most common iconographic types on the obverses? Answered by requesting coin types, and iconographic themes on the obverses grouped by number of occurrences.

```
# Definition of the prefixes
PREFIX dct: <http://purl.org/dc/terms/>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX crm: <http://erlangen-crm.org/current/>


# Variables required
SELECT distinct (COUNT  (?ico1) as ?number_of_ico1) ?mint ?ico1

# The subject of the triples is a coin-type issued in a mint;
# the coin-type has an obverse face (?face1)
# that carries an image (E36_Visual_Item) with a description.
WHERE {
  ?coin_type a nmo:TypeSeriesItem ;
             nmo:hasMint ?mint .
  ?coin_type nmo:hasObverse ?face1 .
    ?face1 a  crm:E36_Visual_Item ;
          dct:description ?ico1 . }

# Group and display in ascending order by mint and descending order
# by number of repetitions of the iconography.
GROUP by  ?mint ?ico1
ORDER by asc(?mint) desc(?number_of_ico1)
```

Analytical query 7b: What are the most common iconographic types on the reverses? Answered by requesting coin types, and iconographic themes on the reverses grouped by number of occurrences.

```
# Definition of the prefixes
PREFIX dct: <http://purl.org/dc/terms/>
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX nmo: <http://nomisma.org/ontology#>

# Variables required
SELECT distinct (COUNT  (?ico2) as ?number_of_ico2) ?mint ?ico2

# The subject of the triples is a coin-type issued in a mint
# the coin-type has a reverse face (?face2)
# that carries an image (E36_Visual_Item) with a description.
WHERE {
  ?coin_type a nmo:TypeSeriesItem ;
              nmo:hasMint ?mint .
  ?coin_type nmo:hasReverse ?face2 .
    ?face2 a  crm:E36_Visual_Item ;
          dct:description ?ico2 . }

# Group and display in ascending order by mint and descending order
# by number of repetitions of the iconography.
GROUP by  ?mint ?ico2
ORDER by asc(?mint) desc(?number_of_ico2)
```

As seen in Appendix 2: Analytical query 7 retrieved the most depicted iconographic themes in the coin-types of Ulterior-Baetica. The value of this query lies on its capability to retrieve iconographic information about the coins in a systematic way. The Nomisma dataset does compile similar information about Roman Republican coinage however, this sort of data is not available for the Iberian Peninsula. ERUB is the first dataset that makes available a systematic catalogue of the mints and coin-types from Ulterior-Baetica, providing the possibility to query for specific iconographic or linguistic phenomena. This is important because it will allow one to assess whether this method of retrieval can produce valid results and save time and effort to the researcher. As seen in the query, the retrieval of specific information about the iconographic display is possible thanks to the reutilisation of properties from the Nomisma and the CIDOC-CRM ontologies. The semantic modelling carried out allows the query to retrieve information about the obverses and reverses of the coins including the iconographic themes depicted on them and the description of these. The possibility to obtain all this information at once allows the researcher to draw quantitative conclusions on the repetitions of certain patterns over certain mints rather than having to analyse each coin-type separately.

The iconographic themes retrieved by the query tend to embody anthropomorphic effigies of deities on the obverse in conjunction with non-anthropomorphic motifs on the reverse mainly related to agriculture, marine motifs or star signs. Unsurprisingly, marine types including tuna, tarpon, dolphins, ships or the effigy of the marine Melqart in combination with tunas or dolphins predominate on the reverse at mints located around the coast or in important river valleys such as Guadalquivir or Guadiana. The query retrieved certain exceptions such as the mints of Lascuta or Alba. These results agree with García Bellido/Cruces Blázquez (2001, 69) who considered these exceptions as a desire to imitate towns that were trading partners, for example Lascuta that imitated the types from Gades and Alba minted coins with the effigy of Herakles-Melqart similar to the coins produced in the coastal cities to which the city exported minerals. Another reason could be an allusion to the mythical origins of the communities related to the sea or a god as in the case of Butrobriga, a mint located in the interior province of Badajoz (Extremadura) that minted reverses with the iconography of a ship combined with a dolphin.

In the case of mints located in the interior, the reverse types vary between animals (a boar, bull, horseman, elephant or very rarely a wolf) and agrarian motifs (ears of corn, grapes, vine shoots, cornucopias and very rarely palm trees, possibly alluding to Tannit). Motifs alluding to the stars and the moon are very commonly combined with the representation of a bull. These have been interpreted as an allusion to Punic deities mainly Baal-Hamon and Astarte/Tannit (Garcia y Bellido/Cruces Blázquez 2001b).

The representation of the bull was a long-standing tradition in the cultural imagery of the ancient Mediterranean and was especially associated with religious practices and the funerary world. Other interpretations of this animal have been related to the power of fecundity and astral deities (Blázquez Martínez and García-Gelabert 1997, p.417). One of the most common deities associated with the bull is the Punic god Baal-Hamon, the main god of Carthage. On the Iberian Peninsula, the cult of the god dates back to the 8th century BCE according to the chronology of the coins found in Phoenician enclaves. Therefore, the relation between the animal and the Phoenician deity may explain the depiction of the bull in Phoenician foundations.

Astarte-Tannit was the partner of Baal-Hammon in the pantheon of Carthage. The power of the goddess was related to the stars as she normally appears together with stars and crescents. In many cases, images of bulls and stars are combined with a representation of a female head on the obverse and display a similar iconography to that of African *stelae* with representations of Astarte (García y Bellido 1991, 42). The combination of these motifs alludes to a significant Semitic element not just on the coast, but all over the province as has also been stated previously (More Serrano 2019).

The Phoeno-Punic imagery seems to predominate throughout the dataset either in the effigies of certain deities such as Herakles-Melqart (the most-represented image), Astarte-Tannit (in different versions combined with agrarian motifs, star signs or as a goddess of war) or animals that alluded to them. To visualise the most common types, the following graphs show a statistical analysis of the representation of the different iconographies. These have then been divided in two groups (anthropomorphic and non-anthropomorphic).

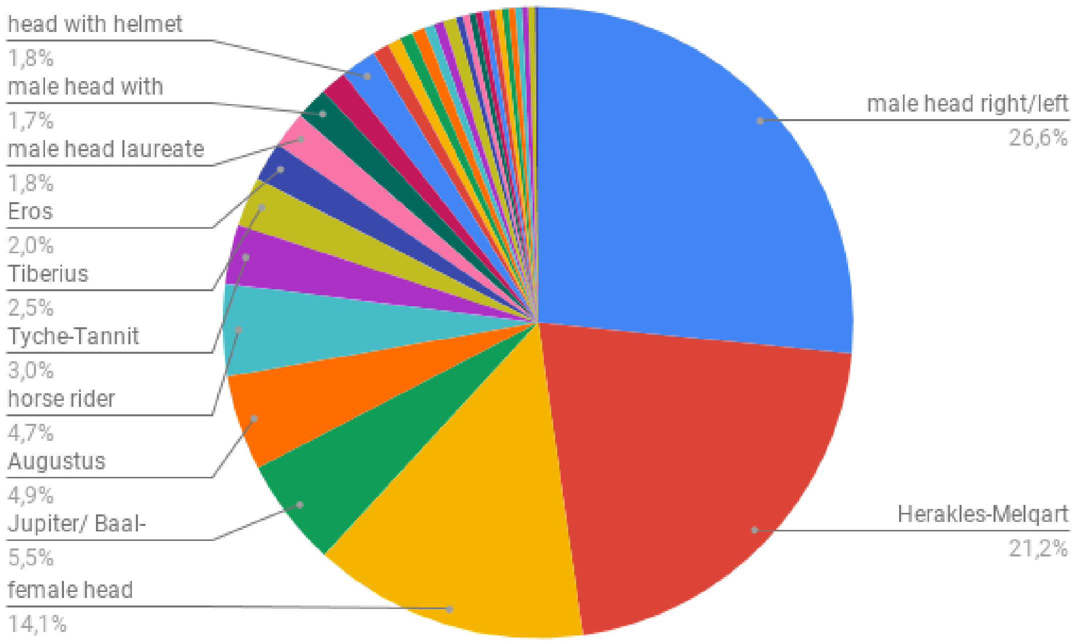

Fig. 9.1. Occurrence of anthropomorphic iconographic themes on the coin-types in ERUB.

Fig.9.1. shows that the most represented type is a male head that has not been identified with any specific deity or emperor. Other male heads with specific iconographic elements such as the *laurea* or a hairband appear in the graph, but the quality of the image does not allow for a definite identification. The next most represented figure is Herakles-Melqart, the main deity of Tyre, later one of the three principal gods of Carthage. Although he was first related to agriculture, he later became a marine god associated to the sea and thus commerce in the Phoenician tradition. Herakles-Melqart is the most frequently represented deity in the dataset and will be analysed further below.

Following Herakles-Melqart, the most common type is a female head not clearly specified, which could be identified with Tannit but also with an indigenous goddess; these are then followed by Baal-Hammon, Augustus and the identified representation of Tannit. The graph also shows a number of individual or small occurrences of types including the effigies of certain emperors and deities. This infrequent occurrence could be due to the bad quality of some of the issues that does not allow their precise identification in other issues of the dataset. Nevertheless, as shown in the graph, the least-reproduced types seem to be related with the Roman tradition (e.g., Caligula, Caius, Roma, Livia, Drusus etc.). As explained before, the coinage data in ERUB is dated between the 4th century BCE and the 1st century CE, therefore, the main reason for the infrequency of images of Roman tradition could be the lack of interest in the reproduction of these types in the first centuries of Roman presence compared to the established acceptance of the Phoeno-Punic imagery.

In the case of the non-anthropomorphic representations a similar preference for Punic patterns occurs, as seen in Fig. 9.2. In this case, the tuna fish normally associated with Gades is the most common type with more than 70 occurrences in the whole dataset followed by other types of fish such as the dolphin or the tarpon. Other references to the local economic resources are also very significant, especially corn ears, grapes, and the plough. The perceived dialogue in some cases between the themes depicted on the obverse and reverse of the coins has led scholars to see a relationship between the iconographic types depicted on both sides of the issues in a sort of iconographic narrative that would exploit all the space available on the coin to convey a single ideological discourse (e.g., Alfaro 1988, García y Bellido 1991; Jiménez 2014; Moreno Pulido 2016).

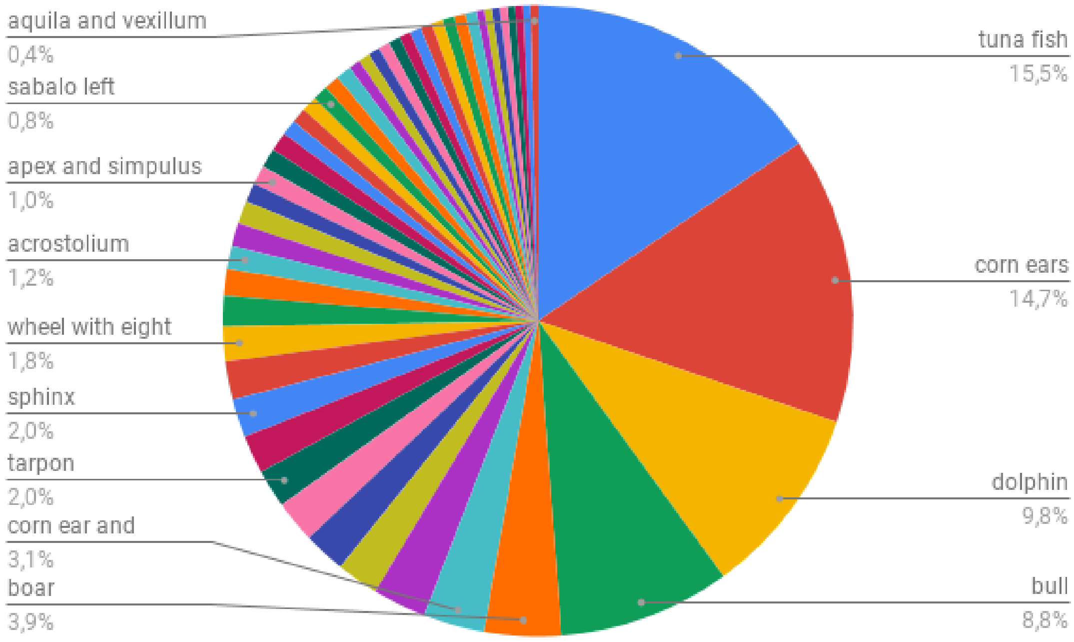

Fig. 9.2. Occurrence of non-anthropomorphic iconographic themes on the coin-types in ERUB.

Examples of this dialogue between obverse and reverse have already been discussed in Chapter 8 regarding the Lybiophoenician mints. Other examples can also be seen in coins outside of the Lybiophoenician group, such as those produced by the mint of Gades where the head of Herakles-Melqart is very commonly depicted with the tuna. This sort of interaction has also been observed by Alfaro, who understands it as a representation of the fish industry of the area (Alfaro 1988, 41) or the identification of the god with the tuna as a maritime deity protector of the city (García-Bellido 1991, 51). Other common motifs are corn ears, a bull and a ship prow (normally considered a Phoenician battleship: Mora Serrano 2012). The figure of Astarte also seems to appear accompanied by the palm tree. The representation of the palm tree in Hispania has been traditionally seen as a Punic influence on the coinage; however, its distribution is limited to the mint of Vesci associated with Tannit and with the mint of Castulo, associated with a male head.

In order to understand the cultural influences that could be identified in each of the images represented, the following table (9.1) displays the analysis of the two graphs provided above. The most common representations are classified according to their type, and the cultural influences that can be perceived in them. This table has no parallels in previous scholarship, and it has been made possible by the systematic analysis of the coins enabled by the modelling of the data and the SPARQL queries above.

Type	Phoeno-Punic	Hispano-Punic	Hellenistic-Greek	Italo-Roman	Iberian
Deity or mythical hero	Herakles-Melqart Baal-Hammon Astarte-Tyche-Tannit Hephaestus	Female goddess Male head	Herakles-Melqart Neptune Apollo Europa? Horseman?	Jupiter Rome Victory Eros Mercury Vulcan Artemis Imperial images	Female goddess Horseman
Animal	Tuna Dolphin Tarpon Bull Elephant Sphinx	Antelope Horse Unicorn? Bull Boar	Sphinx Bull	Wolf feeding the twins	Bull Boar Horse Wolf
Other motifs	Crescent Star signs Bunch of rays Altar? Corn ears Palm Tree Vegetal wreath Pine cone		Lyre Temple Altar? Ship prow Trident	Cornucopia Eagle Altar?	Corn ear Grapes

Table 9.1.Classification of coin imagery in relation to the different cultural influences.

As can be seen the table above (9.1), the representation of the Punic triad (Herakles-Melqart, Astarte-Tannit, Baal-Hammon) appears normally related with star signs, crescents, palm trees or vegetal decoration such as vegetal wreaths. These three gods represent the most commonly represented triad in the coins. The cult was imported to the Peninsula by Phoenician communities as a Phoeno-Punic iconographic type but later reinterpreted and adopted by the indigenous communities to become a fundamental part of the local imagery and cultural tradition. Animals associated with the Punic triad are the tuna (mainly in Gades, from where the type spreads) dolphins, tarpons, bulls, sphinxes and elephants (the latter has been related to African influences or even a purely African iconography (Mora Serrano 2018)). Within the Hellenistic types, one should again include the representation of Melqart, in this case represented more in his classical imagery influenced by the Hellenism of the Barcid family, but also a series of effigies of the god Apollo and other Apollo-like representations. These images can be seen for example in mints such as Obulco and Castulo/Kastilo.

To analyse the main figures depicted, as well as the most commonly represented deities and to retrieve further information about them, the following query AQ.8 can be framed within a federated query. It retrieves the names of the figures depicted on the coins of ERUB and runs a second query in the DBpedia SPARQL endpoint to gather further information about them as well as an available image of the figure in order to trace iconographic parallels if possible.

Analytical query 8: What are the most represented gods/authorities in the coin-types from ERUB and what information is there available in DBpedia for them? Answered by requesting the number of coin-types that represent a specific god/authority and running a sub-query in the DBpedia SPARQL endpoint to provide further information.

```
# Definition of the prefixes
PREFIX foaf: <http://xmlns.com/foaf/0.1/>
PREFIX geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
PREFIX skos: <http://www.w3.org/2004/02/skos/core#>
```

```
PREFIX dcterm: <http://purl.org/dc/terms/>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX foaf: <http://xmlns.com/foaf/0.1/>

# Variables required
SELECT DISTINCT ?mint ?latitude ?longitude (COUNT (?coin_type) as
?number_of_coin_type) ?god ?depiction

# The subject of the triples is a coin-type issued in a mint
# the mint has a location with latitude and longitude.
WHERE {
 ?coin_type nmo:hasMint ?mint .
 ?mint geo:location ?location.
 ?location geo:lat ?latitude;
    geo:long ?longitude.

# the coin-type has a nmo:type series. Either the obverse or the   #
reverse portray something, which will later match to the deities
 ?coin_type a nmo:TypeSeriesItem
  ; (nmo:hasObverse|nmo:hasReverse)/nmo:hasPortrait ?god

# The service declaration to run the query on the DBpedia SPARQL
# endpoint looks for the resources that match the provided graph.
 SERVICE <http://dbpedia.org/sparql> {
# The possible ways in which something in DBpedia can be
# assimilated to a deity, through linguistic (GOLD)
# or taxonomical (SKOS) predicates.
   { ?god <http://purl.org/linguistics/gold/hypernym>
<http://dbpedia.org/resource/God>
      } UNION {
    ?god dcterm:subject/skos:broader?
<http://dbpedia.org/resource/Category:Deities>
      } UNION {
    ?god dcterm:subject/skos:broader?
<http://dbpedia.org/resource/Category:Goddesses>
   } }

OPTIONAL {
# The last pattern is optional as it is not guaranteed
# that every deity has a picture in Wikimedia Commons.
   ?god foaf:depiction ?depiction.
 }
}
# Group results by god and descending order by number of coin-types.
GROUP by ?god ?depiction ?mint ?latitude ?longitude
ORDER by desc(?number_of_coin_type)
```

Analytical query 8 formulates a graph pattern to query for mints and most common images in ERUB. It then calls the DBpedia endpoint by using the keyword SERVICE to retrieve DBpedia resource URIs for the gods and Wikimedia Commons depictions. The value of the query relies on its capacity to retrieve a significant number of images and external resources (i.e., URIs, images and further information) for the deities requested. Traditional methods would require the researcher to manually identify each of the images by using Google image search or other image browsers, requiring therefore a much larger amount of time and effort. In this way, by using one single query, the researcher can a) enrich the data with DBpedia URIs and b) discover further information and images about the deities researched. A query like this may represent certain complexities, mainly because it is run from a local repository, so it needs the installation and setting up of the endpoint as we have done here with Fuseki, but also because it needs the user to acquire certain familiarity with the data that will be queried, in this case DBpedia. To find out the DBpedia properties that were needed to run this query, it was necessary to run certain exploratory queries on the DBpedia repository. This additional effort can demotivate users from using this sort of services, nevertheless any databases require some sort of understanding prior to its use, in some cases requires very specific knowledge. Instead, with LOD, familiarisation with main semantic schemas such as FOAF or SKOS can be very fruitful in dealing with very diverse repositories.

As explained earlier, federated queries are the optimal approach with LOD, they allow the retrieval of data from different repositories avoiding the need to download and query them locally. Nevertheless, federated queries can also be very problematic because of reasons normally related to endpoint availability and the blocking operators that are usually implemented.[158] Because of this, despite specific developments such as the OpenArchaeo project, previously discussed, the federated approach has still not taken off in archaeology-related datasets, it is still difficult to find fully workable endpoints to run federated queries across archaeological repositories. Because of this, Analytical query 8 relies on the DBpedia endpoint to assist iconographical research on archaeological data and it helps to provide a sample of the kind of results that could be obtained if federated queries were implemented by archaeological repositories.

As seen in Appendix 2, Analytical query 8 provides a table with the number of coin-types that can be identified for each god, together with the mint, geographical coordinates and, in the last column to the right, if possible, a depiction of the traditional imagery of the god as provided by DBpedia, which can be useful to trace parallels with the iconography depicted in the coin in the research process.

The results retrieved by the query show that the most prominent deities are Herakles-Melqart, Baal-Hamon and Jupiter, and in smaller number, Astarte-Tannit, Augustus and Tiberius. The significance of Punic deities is obvious, Herakles-Melqart being the most common figure not just in Gades but also in Asido, Lascuta, Iptuci, Carmo and Sexs and even in other mints which do not necessarily correspond to the Phoenician sphere such as Carisa Aurelia. Other representations that cannot be directly identified with a specific deity, for example the female head on the coins of Obulco, are however not returned by the query.

[158] See pages 167-168 for the reasons why federated queries can be problematic.

In the field of Hispanic numismatics, the representation of Herakles-Melqart has been considered an imported image brought to the peninsula by Phoenician communities; nevertheless, the common depiction of the god in the numismatic record, as well as his temple and the worship in Gades (Cádiz) and its hinterland, should not be understood as a foreign cult imposed on the area, but as a well-established cult that had meaning for the communities settled in the territory. The god became part of the cultural imagery of the peninsula and his image was recreated, reconfigured and replicated by the communities there as attested by the numismatic record and also by the temples, statues and sanctuaries dedicated to him. The representations of the god should be seen in combination with two other significant Punic deities, Baal Hammon and Astarte-Tannit, the Punic triad with strong roots in the south.

In the case of the anthropomorphic representations, the theme of Herakles-Melqart is especially significant because of the number of images and the variety of types that the coins depict. The following query retrieves the different representations of Herakles-Melqart in the coinage by using a syntactic filter. This is a less robust approach that the federated query used with the DBpedia repositor because it relies on syntactic aspects, but may be necessary when there is no finite entity set to match. The results comprise 53 different coin-types with representations of Herakles, provided in Appendix 2: Analytical query 9. The results have been summarised and analysed in Table 9.2.

Analytical query 9: What are the different representations of Herakles-Melqart? Answered by requesting all the coins with representations of Herakles-Melqart, a male head with a lion skin or a club.
`# Definition of the prefixes` `PREFIX dct: <http://purl.org/dc/terms/>`

```
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>

# Variables required
SELECT (count (distinct ?coin_type) as ?number_of_coin_type) ?mint
?lat ?long ?ico

# The subject of the triples is a coin-type issued at a mint.
WHERE {
?coin_type a nmo:TypeSeriesItem ;
       nmo:hasMint ?mint .

# Retrieve mint location and coordinates, where available
  OPTIONAL {
?mint geo:location ?loc .
?loc geo:lat ?lat ;
   geo:long ?long . }

# Retrieve the textual description of either face of the coin.
?coin_type nmo:hasObverse|nmo:hasReverse ?face .
  ?face a crm:E36_Visual_Item ;
     dct:description ?ico .

# Filter by the description of the images in obverse/reverse that.
# contains the words ‘Melqart’, ‘lion’ or ‘club’.
 FILTER(CONTAINS(str(?ico),"Melqart") || CONTAINS(str(?ico),"lion")
|| CONTAINS(str(?ico),"club")) }

# Group by number of coin-type
group by ?number_of_coin_type ?mint ?lat ?long ?ico
```

number_of_coin_type	Mint	Iconography	Type
1	Carteia	male head with lion skin (Herakles-Melqart)	1
1	Carteia	head of Herakles-Melqart with lion skin two globules	2
1	Carisa	male head with lion skin	1
1	Castulo/Kastilo	male head right and club	7
5	Salacia	Herakles-Melqart head left with lion skin and club	3
2	Bailo	Herakles Herakles-Melqart head with lion skin and ear left	4
2	Searo	Hercules-Herakles-Melqart head with lion skin right	1
3	Carmo	Male head (Herakles-Melqart) right with lion skin	1
1	Abdera_Hispania	Male head right (Herakles-Melqart)	5

1	Lascuta	Herakles-Melqart head right with lion skin.	1
2	Carteia	Head of Herakles-Melqart with lion skin	1
2	Salacia	Male head laureated with beard left (African Herakles-Melqart?)	6
1	Gades	Head of Herakles-Melqart frontal with lion skin.	1
13	Gades	Head of Herakles-Melqart left with lion skin.	1
6	Gades	Head of Herakles-Melqart left with lion skin	1
4	Gades	Head of Herakles-Melqart right with lion skin.	1
3	Lascuta	Herakles-Melqart head left with lion skin and club on the shoulder	3
2	Sexs	Herakles-Melqart head left with club	7
1	Salacia	Herakles-Melqart head with lion skin and club	3
9	Sexs	Herakles-Melqart head left with lion skin and club	3
2	Gades	Head of Herakles-Melqart	5
2	Lascuta	Herakles-Melqart head right with lion skin and club.	3
1	Carteia	Neptune/Herakles-Melqart? Naked with foot on rock, trident and dolphin	8
2	Salacia	Herakles-Melqart head left with lion skin and club on shoulder	3
1	Asido	Male head (Herakles-Melqart) with lion skin and club	3
4	Iptuci	Herakles-Melqart head with lion skin right	1
41	Gades	Head of Herakles-Melqart left with lion skin and club	3

Table 9.2. Analysis of the results provided by Analytical query 9.

This table shows how the image of the god was adapted and reinterpreted in different ways in some cases related with different iconographic attributes such as the lion skin or the club. I have added an extra column to the table (Type) to classify the different types of representation of the deity and visualise them in a map. The following map displays the spread of the iconographic types for the representation of the god. As seen in Fig. 9.3, Gades exerts an influence in its hinterland with the Type 1 adopted by Carteia, Searo, Carmo, Lascuta and Iptuci. Type 1 depicts the head of the god with the characteristic lion skin but doesn't include the club. The other representation of Carteia (Type 2) is very similar, only adding two small globules which have been identified as possible value marks.

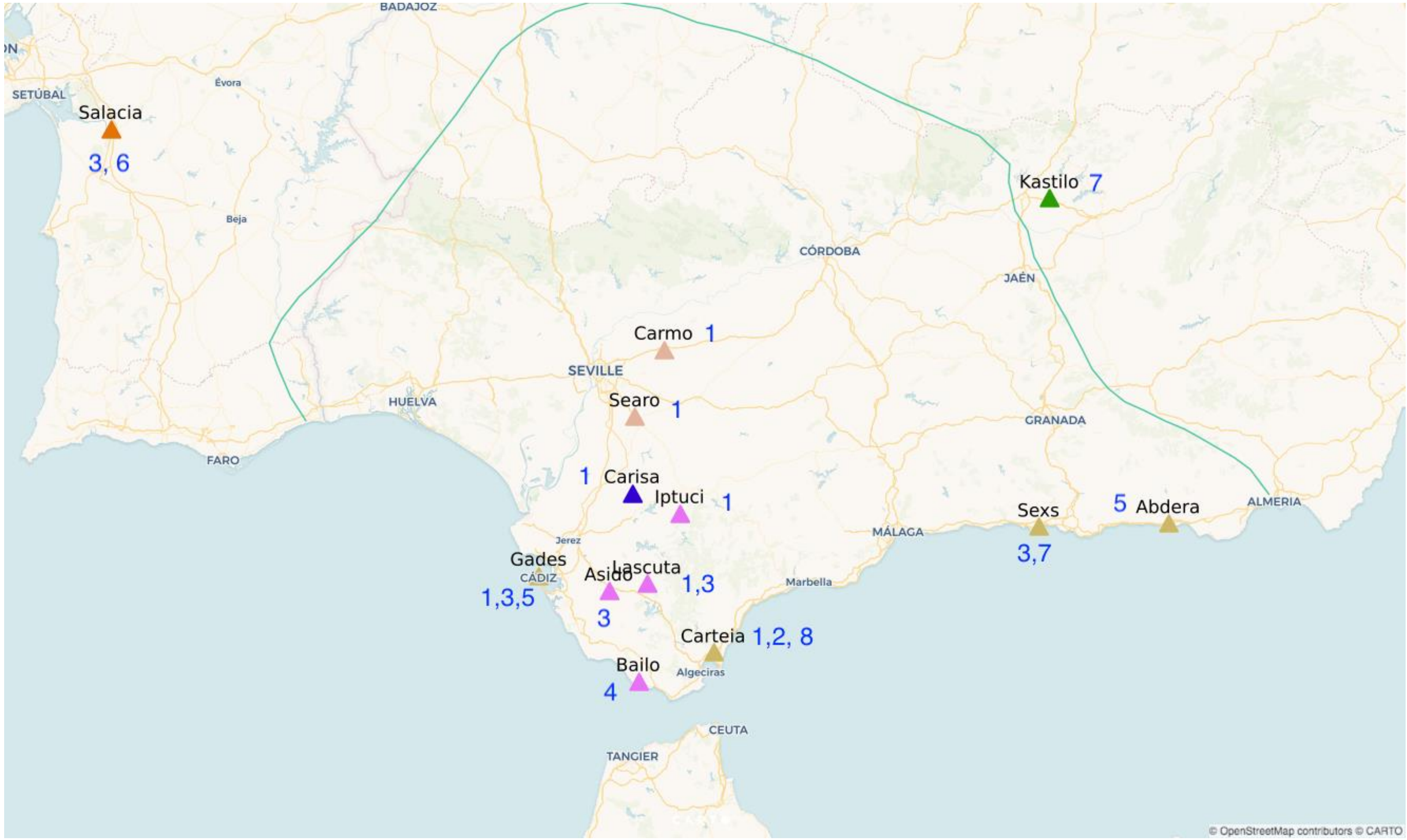

Fig. 9.3. Different iconographic types for Herakles-Melqart. The types are identified by numbers from the table above and pin colours are as follows: yellow: Phoenician mints, fuchsia: Lybiophoenician mints, orange: Salacia (south-western script mints), green :Castulo/Kastilo (south-eastern script mints), pink: Carmo and Searo (Latin), blue: Carisa (mixed).

The other most common representation is Type 3 which includes both the lion skin and the club. Type 3 is also common in the hinterland of Gades, where it is adopted by mints like Asido, Lascuta and Sexi and also a bit further away at Salacia. The representation of the god with only the club seems to be more prominent in the east within the mints of Alba, Sexi and Castulo/Kastilo. Castulo/Kastilo produces coins with male and female representations accompanied by palms, dolphins and crescents on the obverses and bulls, sphinxes and boars on the reverse. The iconography of the obverse presents strong Punic influence; however, they have not been specifically identified with any deity in particular. Examples for Types 1 and 3 can be seen in Fig. 9.4. Other types include the head of the god with an ear of wheat (Type 4), laureated (Type 6) or with a trident (Type 8).

Fig. 9.4. Left: object CE14518 Type 1, silver coin from Gades: head of Melqart with lion skin and curly hair, (337-206 BCE). Right: object CE02835, Type 3 on a bronze coin from Gades: head of Melqart with lion skin and club between (200-19 BCE). (Source: Domus).

The results obtained by this query can be compared to the research carried out by Mora Serrano (2019, 156) where the scholar discusses different representations of the god and proposes possible origins for the main images. Mora Serrano differentiates between

Melqart, without lion-skin, bearded or beardless, laureate or bare-head and sometimes accompanied with the club. He relates the origin of these representations to Sicily, a significant cultural frontier between Carthage and Greece from where the Hellenised image of the god would have also been exported. According to Mora Serrano, the general Gaditaniain image lacks the club whereas the Carthaginian types include the lion skin and, in some cases, show a bearded god and the laurel wreath. The scholar identifies one type of representation more related to the Barcid format, influenced by Tyre which lacks the lion skin or the club. This type was imitated by mints like Abdera in contrast to the Hispano-Phoenician representation which predominates in the Lybiophoenician sphere with mints like Gadir, Bailo, Asido, Iptuci and Lascuta. These influences can also be seen in the map depicted in Fig. 9.3, where Abdera and Gadir seem to share the type 5 'Head of Herakles Melqart' and 'Male head right Herakles Melqart' and Gadir Asido and Lascuta seem to share type 3 'Herakles-Melqart head left with lion skin and club'. This last Hispano-Phoenician type is also identified by the scholar in workshops such as Carissa and Carmo (Mora Serrano 2019, 157). This influence can also be perceived in the data retrieved from AQ.9. As we can see from the map, type 1 'male head with lion skin' is identified in the mints of Gadir, Carmo and Searo.

The research carried out by Mora Serrano relies on the careful identification of the images in the different issues and on the comparison with previously published research on the spread of these images. This approach can more accurately compare thematic and style-related differences between the mints and identify the possible provenance of such influences. However, the queries and results retrieved in this investigation provide a more systematic analysis of the data and the mints in a quantitative way, by relaying on the modelling of the data (i.e., using CuCoO and similar numismatic-related vocabularies like the Nomisma ontology) and on the information collected in the dataset, which in turn in turn relies on the work done by Mora and others in putting together numismatic corpora. Therefore, while the research process is very different in both cases, it is clear that the results obtained share common ground.

In both cases, the results demonstrate the tendency of certain mints to adopt and replicate iconographic types promoted by others, such as in the city of Gades due to economic or political dependence or, in some cases, just because of geographical or ideological proximity. In order to study further the adoption and spread of types, the following query AQ.10. requests all the iconographic descriptions of the obverses and reverses of the coins collected in ERUB to further explore the most commonly reproduced themes among the mints.

Analytical query 10: What are the most reproduced iconographic themes? Answering by requesting the iconographic types and the number of times reproduced in each mint.

```
# Definition of the prefixes
PREFIX dct: <http://purl.org/dc/terms/>
PREFIX crm: <http://erlangen-crm.org/current/>
PREFIX nmo: <http://nomisma.org/ontology#>
PREFIX rs: <http://www.researchspace.org/ontology/>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>

# Variables required
SELECT DISTINCT ?mint (count (?iconography) as ?number) ?iconography

# The subject of the triples to be retrieved has to be a coin-type
# issued at a mint. The coin-type displays an image (?face) in
# either the obverse or the reverse and with a description
WHERE {
?cointype a nmo:TypeSeriesItem ;
             nmo:hasMint ?mint ;
             nmo:hasObverse|nmo:hasReverse ?face.
?face dct:description ?iconography .
}
```

```
# Display in descending order.
group by ?mint ?iconography
order by desc(?number)
```

Analytical query 10 retrieves a table of 588 mints with different iconographies, a sample of 100 results have been provided in Appendix 2: Analytical query 10. The importance of the query relies on its ability to retrieve and group systematically the iconography represented on the obverses and reverses of the coin-types. The possibility to query for the relationship between mints and iconographic patterns is progress towards using LOD analysis to explore art-historical and archaeological questions. To further explore this idea, Social Network Analysis (SNA) can help to better understand the connections between mints and images, and potentially, using the images to connect the mints themselves. [159]

SNA applied to the iconographic patterns of the mints can help to examine cultural contact relationships between the cities. Network analysis can show which mints display more relationships to others in the whole set and which mints are isolated within the network. The following graph, made with Gephi, displays the network of relationships amongst the different mints of ERUB by visualising the connections between the mints (nodes) related by the iconographic type shared (edges). To generate this graph, I first cleaned the data to make sure that similar depictions in the coins were described with similar semantics (e.g., Herakles-Melqart head looking right is the same as Herakles-Melqart looking right). After that, I created a spreadsheet with the nodes (including the

[159] Social Network Analysis (SNA) is a method to investigate interactions through the use of networks and graphic representations. It explores networks of connections in terms of nodes (individual actors within the networks represented with a point) and edges (connections, relationships or interactions between the nodes represented with lines in the network graph).

mints and their IDs) and the edges (including the mints and their representations). A sample of the data is provided in the table below.

ID	Label
1	Abdera
2	Abra
3	Acci
4	Acinippo
5	Aipora

Table 9.3. Sample of the 'Nodes' spreadsheet arranged for SNA. This table shows the IDs generated by Gephi for each of the mints.

SOURCE	EDGE
1	temple and tuna columns
48	tetrastile temple
30	tetrastile temple surrounded by vegetable wreath
1	tetrastile temple with closed door
1	Tiberian head right with laurea
61	Tiberius head laureate left
40	Tiberius head left
41	Tiberius head left
61	Tiberius head left
40	Tiberius head right

Table 9.4. Sample of the 'Edges' spreadsheet arranged for SNA. The table displays the edges (types of iconographies) that connect the different sources (mints). The different edges are repeated among the mints that share similar iconographies.[160]

[160] Note that certain mints display iconography of Tiberius, this is due to the presence of Tiberian images in the coinage of Ulterior Baetica as early as 37CE. Since the scope of this research is 4th century BCE to 1st century CE. I have included these examples in the data.

I then uploaded this data to the Gephi software and applied the multinetwork plugin to connect mints with mints instead of mints with representations so if mints A and B represents Herakle, the network will interconnect both mints.

Source	Target	Type	Id	Label	Weight	MMNT-EdgeType
1	22	Undirected	593	false-false	3	false<--->false
1	30	Undirected	594	false-false	6	false<--->false
1	31	Undirected	595	false-false	1	false<--->false
1	39	Undirected	596	false-false	1	false<--->false
1	40	Undirected	597	false-false	2	false<--->false
1	41	Undirected	598	false-false	1	false<--->false
1	44	Undirected	599	false-false	2	false<--->false
1	47	Undirected	600	false-false	1	false<--->false
1	48	Undirected	601	false-false	1	false<--->false
1	53	Undirected	602	false-false	3	false<--->false

Table 9.5. Sample of data converted with the multiple node plugin.

For an easier visualisation, I have applied the Fruchterman Reingold algorithm, a force-directed layout algorithm that represents nodes with similarities in closer areas of the network. The results of the SNA are displayed in Fig. 9.5.

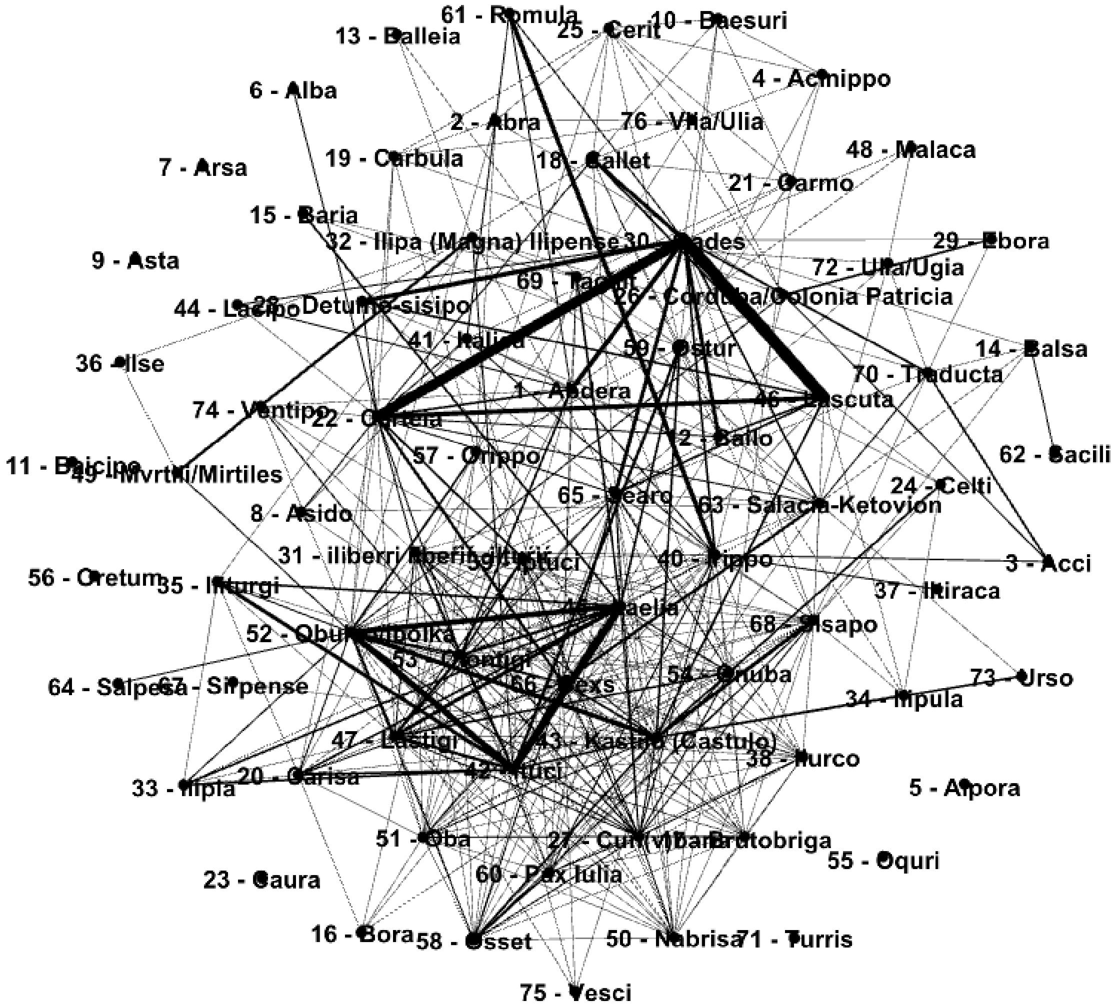

Fig. 9.5. Thematic iconographic relationships between different mints in ERUB. Black points are 'nodes' representing mints and black lines are 'edges' representing iconographic connections between them.

Fig. 9.5 shows certain mints represented as isolated nodes on the verges of the network (e.g., Aipora, Oquri, Caura, Turris etc) because the iconographic themes reproduced by these mints, do not show matches with the rest. On the other hand, the mints represented in the centre are those that present the most similarities. One could argue that the mints with more similarities are those in which the iconographic theme originated, but the kind of analysis developed here does not allow us to see this: it only tells us whether or not the pattern was shared with different nodes in the network.

As explained, this method allows one to trace relationships in the network that otherwise would be very difficult to see in a table with hundreds of items. It represents an automated analysis because it is systematic, which is one of the strengths of applying LOD to archaeological research. This method establishes connections between any nodes that display similarity in the description of the themes represented, regardless of the quality of the link. There has not been similar network analysis previously undertaken on the coinage record of Ulterior-Baetica, because of this, it is not possible to compare the results obtained with previous scholarship. Nevertheless, it is possible to compare small sets of information obtained from the networks with previous iconographical research on the mints.

A potentially noteworthy feature of the network is the weight of the connections. The weight represents the significance of the connections in the network based on the number of occurrences of the iconographic theme in the dataset. The variable 'weight' is represented in the sixth column of table 9.5. and has been created automatically by Gephi. As we can see in table 9.5, the highest weight in the sample of data is attributed to the connection between Source 1 (Abdera) and Target 30 (Gades). In the network, the edge that represents this weight is slightly darker than others: this is because there are more occurrences of similarities between these two nodes than others.

If we compare this result to previous scholarship, we can see how the main figures identified in Abdera are a potential image of Herakles Melqart (male head with club) with dolphins on the reverse and a potential image of Mercury (male head with helmet and Petaso) with dolphins and tuna on the reverse (see García Bellido, M.P./Cruces Blázquez, 2001b, 17-18) which are two of the main themes represented in the mint of Gades. The association is confirmed, quantified and contextualised by the slightly higher weight of the connection in the sample found by the network analysis.

Going back to the graphical representation of the network (Fig. 9.5.) one can see that the heavier edges are those that connect Gades with Carteia and Lascuta. This means that similar iconographic themes are repeatedly represented between these three mints. If we compare this result with previous research on the iconographic discourse of the mints, we can see that a representation of Herakles-Melqart with lion skin and club is often shared by Gades and Lascuta (see García Bellido M.P./Cruces Blázquez 2001b pages 147-153 for Gades and pages 265-266 for Lascuta). Conversely, in the case of Carteia, the most represented image on the obverses is a potential image of Baal Hammon (García Bellido M.P./Cruces Blázquez 2001b, 87), nevertheless, the reverses of Carteia display themes that are commonly seen in Gades such as the dolphin, the ship's prow and in some cases the star (García Bellido M.P./Cruces Blázquez 2001b, 147-153). The graphical representation of the network and the relationships explored here constitute an approach that can allow LOD and SNA to contribute substantially to discussion of cultural contact in the mints.

The use of ERUB data, the CuCoO modelling and SPARQL querying has enabled this research to systematically retrieve iconographic data for the coin types collected in ERUB. The analyses of the data with the appropriate method, in this case SNA, has enabled reaching conclusions regarding potential iconographic connections between the mints. Obtaining these conclusions in a systematic and relatively quick way is best achieved using this method. The following section looks at iconographic contact in the sculptural record within the context of previous findings.

9.4. Querying and analysis: visual media

The study of coinage in Ulterior-Baetica has allowed to identify the spread of certain types in the iconographic discourse of the coins. The second section of this chapter will be focused on the sculptural record of the province of Ulterior-Baetica. Traditional scholarship has been mainly concerned with the different changes seen in sculptural style, and how these intensified from the 2nd century BCE to the Caesarean-Augustan period (Jiménez/Rodá 2015, 488). These changes included the spread of new iconographic patterns, but also, and more widely acknowledged, the rupture between the continuity of local practice and the introduction of new Roman traditions.

Most current scholarship on this question (Jiménez 2008, 2011; Jiménez and Rodá 2015; Noguera Celdrán 2006; 2008) has proposed different ways of understanding the confluence of indigenous and Roman influences in sculpture. The theory of hybridisation (Jiménez 2008, 2011; Jiménez/Rodá 2015; Noguera Celdrán 2006) considers the combination of different visual languages displayed in the sculptural record of early Roman Spain to be a consequence of the changes experienced by the different communities established in the area within a process of cultural interaction. The new visual languages adopted are no longer considered 'Iberian' or 'Roman' but as the product of a new hybridised context.

The theory of bilingualism has been applied to this particular context by Rodriguez Oliva and Noguera Celdrán (2008), who understand the confluence of the indigenous technique and style with Hellenic-Roman iconography and typology perceived in the sculpture of the province from the 3rd to the 1st century BCE, as a product of the bilingualism of the artistic language. This is seen as a direct consequence of the processes of cultural interaction, similar to the bilingualism in the coin legends of the province. This view is especially interesting as it constitutes one of the first attempts to draw parallels between the iconographic repertoire of the coins and the imagery depicted on stone.

However, a common feature of these theories is that they mainly rely on the identification of two sorts of cultural influences: Iberian, recognised as the original cultural identity of the workshops in which the pieces were made, and Roman, interpreted as the 'aspiration' of the local Iberian workshops to depict new iconographic trends imported both by Italians and Romans and whose imitation would imply a certain cultural, social and political status of the southern area of the peninsula. This has led the whole collection of sculpture produced in Ulterior-Baetica province from the 3rd century BCE to the 1st century CE to be called Ibero-Roman, Romano-Iberian or even Roman-Republican in all previous scholarship (Balil 1989, 223). This is an oversimplification given the varied cultural influences that can be perceived in the pieces that are not just Iberian but also Phoeno-Punic, Greek, Egyptian and Hellenistic.

When exploring the visual landscape regarding the representation of iconographic types in the sculptural tradition, the image seems to be very different to that displayed by the iconography of the coins analysed in the previous section. The following query requests the iconographic types most represented in the sculptural dataset visualised in Fig.9.6.

Analytical query 11: What is the most common iconography in the sculptural record? Answered by requesting iconographic types and the number of occurrences.

```
# Definition of the prefixes
PREFIX cucoo: <http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>

# Variables requested
SELECT (count(?iconography) as ?number_of_iconography) ?iconography

# The subject of the triples is an object that has cucoo:type sculpture
and depicts some sort of iconography.
WHERE {
 ?statue a cucoo:sculpture ;
          cucoo:depicts ?iconography .
}
#Group by depicted object and display in descending order.
GROUP by  ?iconography
ORDER by desc (?number_of_iconography)
```

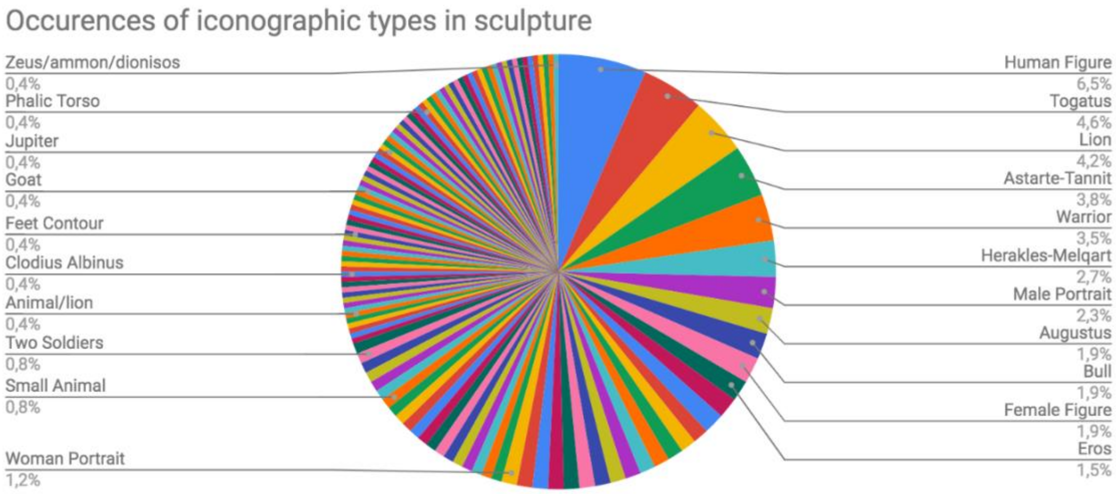

Fig. 9.6. Most depicted iconographic types in sculpture.

Analytical query 11 retrieved a table of 160 entries listing the iconographic themes and the number of occurrences of each, a sample of 60 entries has been provided in Appendix 2: Analytical query 11. The value of this query is its capacity to retrieve systematic results in regard to the iconographic display of the sculptural record of ERUB. To obtain the same sort of results, traditional research methods would require a long exploration of the same sort of data queried here perhaps through several catalogues or similar sources for the sculptural record of Ulterior-Baetica. In this way, a simple query can retrieve the number of occurrences of the different iconographic themes which will then contribute to further historical and archaeological discussion. As previously said, the sculptural data collected in ERUB is not necessarily representative of all the sculptural objects produced in Ulterior-Baetica from 4th century BCE to 1st century CE since the data has been manually collected using web-exposed datasets and by no means represents a comprehensive collection. Nevertheless, it does allow one to evaluate the method and, in this case, to explore whether the results obtained could be to some extent representative of a larger dataset. Furthermore, the systematic querying of both the coinage and the sculpture graphs, allows us to compare the iconographic themes most represented in both sets.

The sculpture dataset is not as large as the coinage dataset, but we can still see the prominence of certain iconographic types. The most represented theme seems to be a non-identified human figure; this is not surprising as the dataset contains several non-identified human-like statues and votive offerings that could represent several different images. Next, the most represented themes are the *togati*, Astarte-Tannit, Herakles Melqart and Augustus.

The occurrence of oriental images such as Astarte and Melqart in the dataset is due to the Astarte-Tannit terracotta pieces and the small figurines of Hercules-Herakles-Melqart in Gades, as might be expected due to the importance of the deity and the temple there

(Álvarez/Corzo 1993-1994, 68). There are also representations of Astarte in Gades, Torreparedones and Ostippo (Estepa, Sevilla) (in this case the evidence is the vegetal decoration of a column which probably was part of a sanctuary dedicated to the goddess). The image of Augustus became fundamental in the fora of the different *municipia* during the Augustan period explaining its frequency in the data. However, although still significant, the frequency of Punic deities is lower than that found in the coins. Despite the existence of images of Herakles-Melqart and Astarte, there are no occurrences for the figure of Baal-Hammon, who is much more significant in the coinage. It seems that the Punic influence that is so clear in the coins is not that apparent in the sculptural tradition. The representation of Graeco-Roman deities such as Venus, Artemis, Eros, Mercury and of course the representation of Augustus and later on, other figures of the imperial pantheon, seem to be much more widespread than iconography related to Phoenician or Punic deities.

The sample presented by the sculptural record seems to be much less monumental than it becomes later in the Roman Imperial period. The sculptures are mostly small figurines and votive offerings which are much more numerous than bigger stone statues. Best-known examples of these are the numerous votive offerings found in Ituci Virtus Iulia (Torreparedones, Baena), some of which have been discussed earlier in this thesis and another known example is the so-called 'Dama de Galera' found in the Iberian necropolis of Tutugi (Cerro Real, Granada). The figure consists of a Phoeno-Punic representation of a woman seated on a throne flanked by two sphinxes with strong oriental influences. Although the statue dates to the 7th century, the Iberian tomb where it was found dates between the 5th and 4th centuries BCE. Together with the terracottas of Astarte-Tannit and the figurines of Herakles-Melqart found in the Gulf of Cádiz (Corzo Sánchez 2005) they all show a strong orientalising tradition which reinforces the Punic presence in the coinage.

Nevertheless, despite the orientalising examples that can be perceived in the dataset, there is still a tendency in traditional scholarship to classify all this production as 'Ibero-Roman' (e.g., Rodriguez Oliva/Noguera Celdrán 2008). The strong Phoeno-Punic influence that can be perceived in the legends and the iconographic repertoire of the coins has not been deeply explored in the sculptural record. In the literature on the sculptural record, only rarely has the iconography of the Eastern Mediterranean, the material or style been considered as evidence for the Phoenician and Punic past of the area (e.g., figurines of Herakles-Melqart found in the Gulf of Cádiz). Although the identification of such features is undeniable in many cases, it has been made on very subjective criteria that tend to keep the pieces within the Ibero-Roman framework and ignore many other interesting influences that should be taken into account.

To move research forward in this area, and to avoid fixed preconceptions about certain objects, the creation of a controlled vocabulary of potential cultural influences depicted in the pieces in a more objective and comprehensive manner can help to develop a better understanding of the objects and draw parallels between similar cultural traits in related datasets. As previously discussed, these 'cultural traits' can be semantically tagged using LOD technologies and displayed in a database such as ERUB. This allows one to contextualize not just the object itself but any of the features that characterize the object, moving away from a rigid categorisation into 'Iberian' or 'Roman' to consider the pieces as something that emerges from a multifaceted process of cultural interaction among the different groups. This way of collecting and structuring the data allows a more faithful representation of the reality of the objects, as well as greater prominence for other sorts of cultural influence, while also allowing the identification of areas with a higher frequency of objects with different cultural influences. The following query counts the number of associations tagged in the sculptures and displays them in descending order.

Analytical query 12: What are the objects with the larger number of cultural influences in ERUB? Answered by requesting all the sculptures and counting the number of cultural associations.

```
# Declaration of prefixes
PREFIX dcterms: <http://purl.org/dc/terms/>
PREFIX geo: <http://www.w3.org/2003/01/geo/wgs84_pos#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX cucoo: <http://www.semanticweb.org/paulagranadosgarcia/CuCoO/>

# Variables requested
SELECT DISTINCT ?statue (count (distinct ?identity) as
?number_of_associations) ?Sculpturelabel ?startDate ?endDate
?URI_museum_reference ?iconography ?museumcontext ?location
?locationLabel

# The subject is an object with type Sculpture with label, dates,
# references, iconography, museum context and cultural associations.
WHERE {?statue a cucoo:Sculpture ;
        rdfs:label ?Sculpturelabel ;
        cucoo:hasStartDate ?startDate ;
        cucoo:hasEndDate ?endDate ;
        rdfs:seeAlso ?URI_museum_reference ;
        cucoo:depicts ?iconography ;
        cucoo:museumCulturalContext ?museumcontext ;
        cucoo:hasCulturalAssociation ?association .

# Second graph pattern to match. Cultural associations of the objects
# related to cultural identities.
 ?association cucoo:isAssociatedWith ?identity .

# Retrieve geographical data for the objects if available.
Optional {?statue geo:location ?location .
     ?location dcterms:title ?locationLabel;
} }

# Display in descending order.
```

```
Group by ?statue ?location ?locationLabel  ?Sculpturelabel ?iconography
?startDate ?endDate ?URI_museum_reference? latitude ?longitude ?label
?museumcontext
order by desc (?number_of_associations)
```

Analytical query 12 retrieved a table of 269 entries. A sample of the top section of the table (the results with more cultural connections) has been provided in Appendix 2: Analytical query 12. This query directly applies the principles of Cultural Contact modelling stated in CuCoO. The objects have been modelled in a way that allows the retrieval of different sorts of information to allow comparison between the different sources.

In the first place, the 'context' of the object has been modelled from the museum reference and is retrieved in the query with the variable (`?museumcontext`). This helps the user to understand the cultural context of the pieces and the type of cultural assumptions that have been previously made about the objects. The data retrieved for this variable in most of the cases provide an ERUB URI that states the context of the object (`erub:Iberian`, `erub:Roman` etc.). In some cases, the object may have two different values for the museum context variable. In that case, the object is repeated twice in the table or as many times as number of different contexts.

In the second place, the cultural associations of the objects have been generated using a series of inference rules. These associations are the product of the main aim of the Cultural Contact Ontology, identify cultural contact in a dataset of archaeological evidence. The data for these associations has been generated through a series of inferences declared through the construct queries explained in section 7.6. These queries allow the modelling and identification of cultural contact by the identification of cultural traits of different origins.

As previously stated, the main mechanism to identify cultural contact in CuCoO relies on the identification of cultural features from diverse provenance in one and the same object. This is done by the connection of the class `cucoo:CulturalTrait` to one of the instances of the class `cucoo:CulturalIdentity` through the property `cucoo:isAssociatedWith`. In this way, the objects that present cultural traits related to different cultural identities are considered in CuCoO as evidence for cultural contact. This is the main contribution of CuCoO that differentiates it from other data models, allowing the query to retrieve those objects that display a higher number of cultural associations and therefore could be considered an example of cultural contact.

In terms of assessing the method, it is important to note that the series of inference rules to obtain culturally enhanced data from CuCoO do not generate new information. Instead, they use a chain of properties to retrieve information that was implicit in the source data. Hence the new data produced was not necessarily unknown but that it was not explicit in the original dataset. This should be taken into account when assessing the validity of the results of the query, which will need to be confirmed by previous scholarship.

The results provided in Appendix 2 illustrate the settlements where the pieces with the most cultural connections have been found; that is, those sculptures in which the data displays more than one cultural association. Fig. 9.7 shows the settlements in a map of the province.

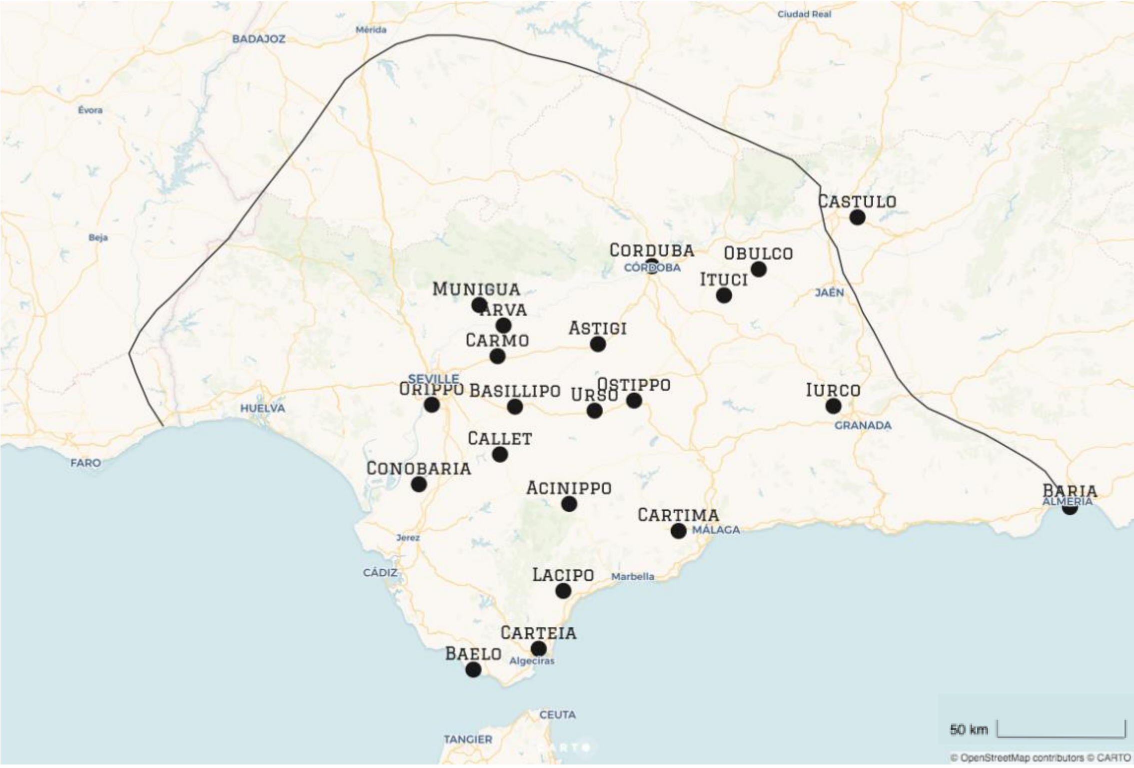

Fig. 9.7. Visualisation of the results from Analytical query 12 on a map with the boundaries of Baetica.

The results retrieved from Analytical query:12 show that the settlements that display a larger number of objects with different cultural associations are: Castulo, Baria, Obulco, Ilurco, Ituci, Corduba, Astigi, Ostippo, Urso, Cartima, Lacipo, Carteia, Baelo, Acinippo, Callet, Conobaria, basillipo, Orippo Carmo, Arva, Munigua. The visualisation of these results in the map above (Fig.9.7) shows that although the centres of cultural interaction in the sculptural record seem to be spread across the province, there are certain concentrations around the south coast in the cities of Baelo, Carteia, Lacipo and Baria and in the north around the Guadalquivir Valley with Orippo, Carmo, Corduba, Obulco, Ituci and Castulo. This can be compared to the results obtained in section 8.3. when we analysed the settlements that stood out of the set because of their concentration of indigenous onomastics. Combining the data obtained from ERUB and Hesperia, the places with a higher number of indigenous onomastics in the epigraphic record were Castulo, Corduba, Obulco, Ilipa, Ilurco, Ituci, Italica, and Urso. When compared, the results obtained in both cases display conglomerations of places with higher cultural contact indexes in the south and the Guadalquivir Valley. The settlements that stand out in both queries are Castulo, Corduba, Obulco, Ituci, Ilurco and Urso.

Another comparison can be made with the results provided by the exploration of the mints that display some sort of bilingual phenomena in their legends. In section 8.4. a series of queries were run to retrieve those mints that display some sort of linguistic contact in their legends. These were displayed in a map that is also shown in this chapter (Fig.9.8).

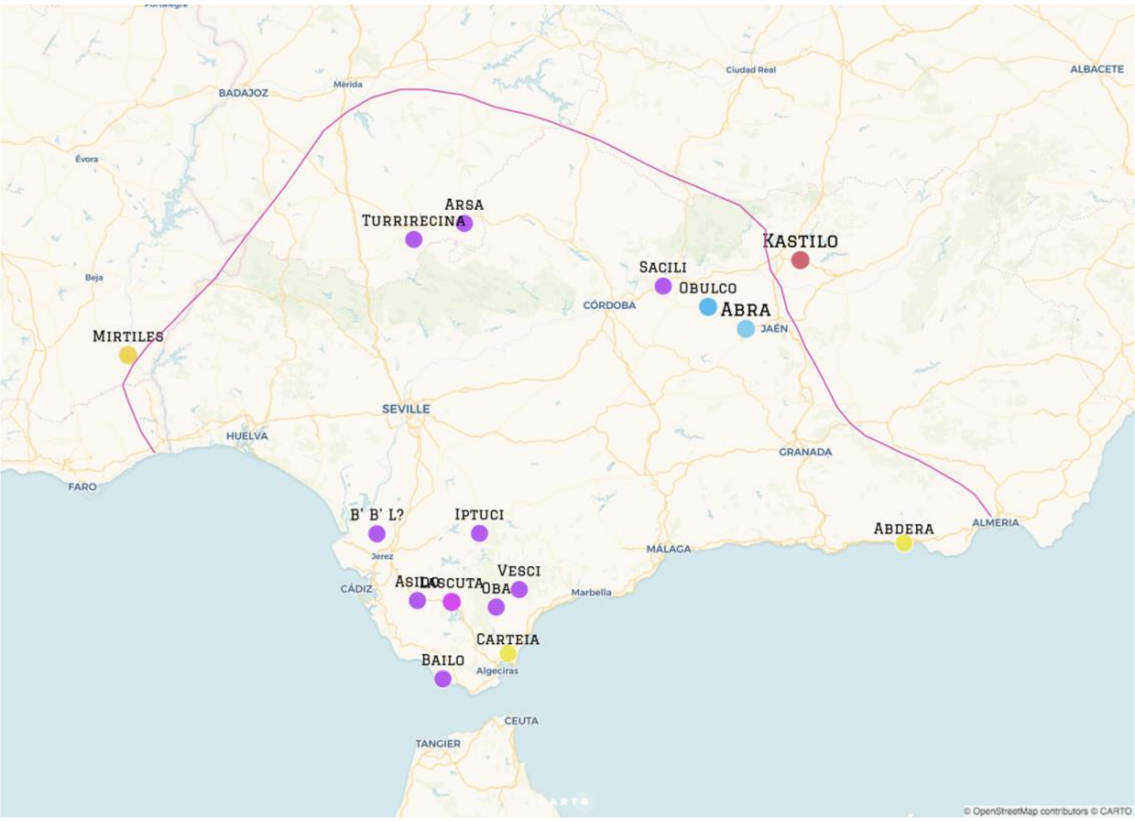

Fig 9.8 (8.16). Mints with bilingual legends according to ERUB within the limits of Baetica: Latin/Punic (yellow), Latin/Turdetanian or Latin/neo-Punic (purple), Latin/Iberian (red), Latin/ southern-Iberian (blue).

The places and mints retrieved in the four different cases display, first, settlements with material culture that presents a significant occurrence of cultural influences; second, settlements that display indigenous onomastics adapted to Latin; and third, mints that display some sort of linguistic contact in their legends. Whereas there are isolated places on each map, many locations that stand out in at least three of the four cases for their connectedness. These are: Castulo/Kastilo (Linares, Jaén), Baelo (Bolonia, Cádiz), Urso (Osuna, Sevilla), Ituci (Torreparedones, Córdoba) Corduba (Córdoba) and Carteia. As such, querying ERUB has identified those places in which cultural contact can be easily perceived in the material evidence.

There have not been any previous studies looking at those places that display a higher number of cultural contact occurrences to compare our results with. Nevertheless, we can assess the validity of the results obtained in the queries above by looking at the cultural context of those settlements, and main features that previous scholarship has illustrated.

In most of the cases, the settlements had a significant historical record that goes back to the ancient province of Ulterior and persists later in Baetica, except for Castulo, which after the Augustan reform is inserted in the province of Tarraconensis (Keay 1998, 13). It is not surprising that Castulo stands out as a centre of cultural contact because of its location in a border area. As explained before, Castulo was the capital of the Iberian territory of Oretania, an important commercial centre from the orientalising period establishing relationships with the Greeks, as shown by the Hellenistic and orientalising influences been found in successive excavations (Blázquez 2007). Their existence, prior to Roman arrival, is one of the main characteristics shared by all the settlements. In most of the cases, they had previous experiences with Phoenician, Greek and Punic colonisation (e.g Carteia, Urso). This could be one of the main reasons why different cultural traditions coexisted and survived in the material culture of these centres after the Roman colonisation. The town of Castulo has already been as the place of origin of the only bilingual epigraph made on stone conserved in Ulterior-Baetica (CIL II 3294). The mint of Castulo/Kastilo was also identified as one of the mints that produced coins with bilingual legends that combined the ancient toponym of Castulo in Latin and sothern-Iberian (see Analytical query 6).

Another interesting example comes from the settlement of Urso (Osuna, Seville) which has been discussed on several occasions in this thesis. The settlement of Urso (Osuna, Seville) was occupied from the 1st millennium BCE, and the city played an important role in the civil war between Caesar and Pompey (Corzo 1977, 55). The importance of the city in the Civil War is narrated in the *Bellum Hispaniense* (22, 1; 26, 4; 61, 2; 62; 1) where it is referred as Ursao. After the battle of Munda, the town ended up under the control of Caesar, who established in 44 BC the *Colonia Genetiva Julia Yrbanorum* under the protection of Minerva and Venus Genetrix (López García 2012, 42). After Caesar took control of the town, Osuna became one of the most urbanised centres of Baetica within the Conventus Astigitanus (Carreras Monfort 1995-196). Throughout the thesis, the town has cropped up because of its importance in the historical record of the province, the significance of its epigraphic record, including indigenous onomastica but also its importance in the sculptural record including a set of monuments which displayed mixed Roman and local influences (see section 7.6). All these concur with the results of Analytical query 12 which identifies these settlements as important centres of cultural contact in the province. Much further archaeological analysis of these centres could be carried out looking carefully at the evidence provided by each of them. However, that is not the main objective of this thesis as opposed to the assessment of the utility of the method demonstrated that has successfully isolated a number of archaeological settlements that do provide evidence of cultural interaction in the different datasets analysed.

The sample of data collected in ERUB is not comprehensive, so the results provided should not be considered representative of the whole archaeological dataset of the province. Nevertheless, the method has successfully provided reliable results in the queries discussed in this chapter that aimed to retrieve patterns of iconographic and cultural contact. Despite the problems of data incompleteness, which are inherent to any dataset, the methodology has proved to be beneficial since it can provide results in a systematic way that can help to reduce the time and effort that would be needed to obtain the same sort of results by traditional means.

9.5. Conclusions

This chapter explored the question of iconographic contact in the ERUB data through SPARQL querying. A set of queries were run to explore the dynamics of cultural interaction in the visual record of the province of Ulterior Baetica. The results obtained from this exploration were then compared to those obtained in chapter 8 to further assess the utility of the method and the reliability of the results obtained.

The analysis of the question of cultural contact in the visual discourse of the coins revealed two different behaviours that can be characterised as differentiation and assimilation.

Differentiation occurred with the selection of certain iconographic types that were alien or non-characteristic of the region. This 'differentiation', intentional or not, individualised the coinage produced by a mint and differentiated it from the other cities. Some mints depict specific types within individualised discourses that point towards certain cultural influences that were not common in the area and can be differentiated from the remainder. Examples of this have been identified through Social Network Analysis in those mints that stood out from the rest of the network and remained isolated from because they could not be related to others by their iconographic themes (see for example Aipora, Oquri, Caura, or Turris from the results retrieved by Analytical query 10). This sort of behaviour is categorised in the CuCoO Ontology as non-permeable cultural contact. The evidence demonstrates that there is cultural contact between different communities in the area, however, a specific iconographic type was not permeated through all the mints.

The assimilation and spread of certain types may imply the desire of certain mints to reproduce the predominant iconographic discourse of the area or of specific cities. This may have been motivated by very different factors such as the emergence of a cultural *koine*, worship of the same gods, economic or political dependence or simply geographical or ideological proximity. Examples of this are more significant in the Punic sphere with figures such as Herakles-Melqart, Astarte-Tannit and Baal-Hammon, or the maritime iconography of the tuna or the dolphin. Certain specific types that gained a strong foothold, such as the representation of Herakles-Melqart, which are considered 'Phoenician' and hence have a colonial or foreign origin, instead spread all over the territory, even reaching mints which are not necessarily considered within the Phoenician sphere. These latter display vriations in the iconographic type, including variation in the style or attributes to modify the iconographic discourse. This indicates the further diffusion of the type even in those communities that did not share a clear cultural connection. This sort of behaviour is typified in the CuCoO Ontology as permeable cultural contact. Permeable cultural contact is according to CuCoO 'a situation of cultural contact where there is evidence for cultural influence'.

Another point that emerged in the exploration of the iconographic types of the mints is the subtle connection between the iconography depicted on the coinage and the iconography of the sculptural repertoire of the province. This relationship has been neglected in traditional scholarship, which focused on the prevalence of Iberian technique in the new Roman models, somehow ignoring the strong Punic substratum that the coinage demonstrates. The occurrence of Punic iconographic patterns in the sculptural repertoire of the province and the entanglement of these with other indigenous and colonial models in specific settlements has been brought to light by the queries run in the second section of the chapter.

Chapter 8 ended with the identification of a) the settlements that display more indigenous names in their epigraphic record and b) the different types of linguistic contact phenomena displayed in coin legends from the mints in ERUB. These results have been compared to the results obtained in Chapter 9 including a) those mints that display a larger number of iconographic connections and b) those settlements that provide a larger number of objects with different cultural associations. The comparison between the results obtained in both chapters showed a number of settlements that stood out from the rest because of a larger number of cultural connections identified in the different datasets analysed (i.e., epigraphy, coinage and sculpture), these settlements were Baelo, Castulo, Corduba, Obulco, Ituci and Urso. As previously explained, the data collected in ERUB does not constitute a comprehensive collection of all the information available either in written or online sources of the archaeological record of Ulterior-Baetica. Nevertheless, despite the inconveniences related to data incompleteness, which are in any case inherent to any archaeological dataset, the methodology proved to be useful at first providing reliable results when compared to previous scholarship, and secondly, retrieving systematic results which can save time and effort in quantitative analysis in comparison to traditional methods.

The queries run in chapter 8 provided different conclusions regarding the utility of the method for epigraphical research. The method proved to be successful in identifying settlements with larger occurrence of indigenous onomastics and in providing mints that displayed some sort of linguistic phenomena in the coin legends. On the other hand, the main limitations encountered were related to the incompleteness of the data available, the technical challenges, and the effort and time required to integrate new data.

Instead, the queries run in Chapter 9 have allowed for a deeper understanding of the modelling of ERUB and the possibilities offered by the culturally enhanced data contained in the dataset. The results obtained in this chapter show the utility of the method to trace cultural connections between different entities by the retrieval of culturally implemented information. These connections have been mapped and analysed using SNA, but they were initially retrieved thanks to the modelling provided by CuCoO and ERUB. Chapter 9 has shown the validity of the CuCoO ontology in its capability to display cultural connections based on common iconographic themes between the mints but also in its capability to associate those settlements with a larger occurrence of objects depicting cultural connections. However, the main benefits of LOD-implemented research shown in Chapter 9 rely on the strengths of CuCoO and the main limitations of the research carried out in this chapter are also deeply linked to the ontology. As discussed in previous chapters, CuCoO classes and properties are fairly *ad hoc* in nature and closely connected to the particular sets of data used for this case study. Because of this, the results are not comprehensive enough to independently support research conclusions and need to be contrasted with and reinforced by previous research, as one might expect. Furthermore, the inference rules used to retrieve non-explicit data from the source dataset are based on a complex chain of properties and therefore should be carefully scrutinised since they do not emerge directly from the data but from the human-guided modelling of the information and the connections established between the entities.

Although CuCoO and ERUB are quite limited in themselves, they are sufficient to critically evaluate the broader utility of the method. As has been demonstrated, the queries run throughout have enabled the retrieval of examples of cultural interaction in both the iconographic record of the coinage and the archaeological record of the settlements and stimulated reappraisals of the evidence and its interpretation.

Chapter 10: Conclusions and future work

Overview:

This thesis has addressed the question of whether LOD-implemented research can be an effective method to investigate dynamics of cultural contact using the case study of the epigraphic and iconographic record of the province of Ulterior-Baetica from the 4th century BCE to the 1st century CE. The thesis has introduced the issue of cultural contact (Chapter 2), examined previous work on Baetica (Chapter 3) and then introduced semantic technologies (Chapter 4) and subsequently applied them to the case study in question (Chapters 5-7). Chapters 8 and 9 focused on the evaluation of the methodology by attempting to answer a series of research questions concerning cultural interaction in Baetica. The discussion identified the benefits and limitations of the method at its most abstract level, but also those of the CuCoO ontology and the ERUB dataset. This chapter discusses key conclusions on the utility of the approach presented in the previous chapters including a discussion of the primary contribution of the thesis, the CuCoO ontology and an assessment of the thesis' input to the problem of cultural contact in early Roman Baetica.

10.1 Structure of the method

The aim of this thesis is the assessment of the benefits and limitations of the methodology proposed for the study of cultural interaction in early Roman southern Spain. Before looking at its utility, one should provide a quick summary of the main themes discussed in previous chapters regarding the method, especially focusing on the theoretical grounds and the technical developments carried out in its development.

The methodology of this thesis was discussed in four consecutive chapters (4, 5, 6 and 7). Chapter 4 explained the concept of the Semantic Web and semantic technologies (including but not limited to RDF, SPARQL and ontologies). It provided an overview of most current projects that combine semantic technologies and archaeology, to explore the growing interest and activity in the Semantic Web. The chapter discussed the main impediments faced by classicists in the application of LOD technologies, namely: the lack of digital expertise and technical barriers, obstacles in the long-term maintenance and dissemination of the resources, the existence of repeated work, and the quality and completeness of the data available online. It discussed how the challenges outlined above can impede the integration of LOD technologies with archaeological research. These difficulties make the implementation of LOD research and its acceptance within the wider academic community still limited, a situation that demonstrates the need for projects like this, that can help to assess the utility of LOD methods, and the time and effort required for them to succeed.

Chapter 5 surveyed the resources currently available online that provide relevant data for the study of early Roman Spain and assessed them according to the Tim Berners-Lee's five-star scheme. The survey showed a remarkable state of the art in most recently published international resources for archaeological research available online. Within the Spanish sector, although the resources proved to provide more complete and curated data, the panorama was less optimistic in terms of implementing semantic technologies. Additional conclusions reached from the different categories in which the resources were classified, showed that, whereas gazetteers and text resources seem to be more willing to incorporate LOD technologies, databases were the more reluctant type of repository to embrace open-access principles. As underlined in the conclusions of the chapter, this situation might be due to problems of compatibility with existing standards, and the potential costs of converting legacy data. The chapter showed that, despite the high quality of the data in Spanish repositories, their value is limited by the barriers to accessibility and processability of the information, a limitation that should be noted by the data providers.

Chapter 6 expanded upon the technical expertise and developments required for the implementation of LOD technologies in archaeological research especially regarding data modelling and integration. The chapter provided an explanation of the processes followed for the collection of data and the integration of it as RDF. It also outlined a certain dissatisfaction with existing ontologies in the cultural contact domain and justified the necessity for the development of an ontology for cultural contact to model the cultural phenomena perceived in the evidence. The chapter also dealt with the technical difficulties that an archaeologist might face in finding the right vocabularies for the description of a specific dataset as well as the technical complexity of translating tabular data into RDF without previous knowledge of programming languages. It ended with a discussion on the main issues that should be taken into account before considering the implementation of LOD technologies, including time investment, technical skills, technical support and potential data available for consumption.

Justified by the research carried out in the previous chapter, Chapter 7 described the development of CuCoO, an ontology for the study of cultural contact in antiquity. The chapter offered an account of the different steps taken in the creation of the ontology grounded in the rationale and the theoretical basis, including the election of certain terms and concepts over others. The chapter focused on the main contribution of CuCoO: its capability to model cultural data and identify cultural contact in a dataset of archaeological evidence from early Roman Spain. As explained, the ontological reasoning of CuCoO relies on the identification of cultural features from diverse provenances in the objects by the connection of the class `cucoo:CulturalTrait` to one of the instances of the class `cucoo:CulturalIdentity` through the property `cucoo:isAssociatedWith`. This allows the ontology to identify those objects that present cultural traits with different provenances. This reasoning is one of the main contributions of this thesis, since it makes it possible to retrieve cultural contact entities. The chapter also engaged critically with the inference rules used to generate new data from the already-existing evidence. The construct queries used to define the CuCoO inference rules adopt a rule language that defines the categories online on the basis of the attributes already specified, hence not generating new information, but making explicit the information that was already implicit in the data. This shows that this approach still needs to be further developed, at least in the field of archaeology. Finally, the chapter also underlined the ad hoc nature of CuCoO that should not be taken as the definitive representation of the domain of cultural contact in antiquity but as a tool to explore this question though the lens of ontological modelling.

This section has summarised the contents of the chapters that explained the theoretical foundations and the technical structure of the methodology proposed in this research. Having laid out the basis of the method, the next section focuses on the analysis of the benefits and limitations that have arisen from the application of this method to give answers to specific research questions in the domain of cultural contact in early Roman Spain.

10.2. Benefits and limitations of LOD implemented research

This thesis has provided an overview of the processes followed to generate an LOD dataset implemented by a newly created ontology to explore a specific research question. The processes explained have never aimed to be a recommendation of best practices, but an example of possible solutions for similar projects that may face similar challenges. For each of the processes described, different approaches could have been taken and the procedures described are only one of the possible solutions. Likewise, as it has been repeatedly said through the previous chapters, the aim of this thesis has never been to look at the whole process of LOD implementation as a monolithic development but to explore more closely significative benefits and limitations including the cost in time and effort of each of the elements and steps involved in the procedure. The following section provides an overview of the most notable benefits and limitations of the integration of LOD technologies to give answer to the following research question: *How can LOD technologies help in the understanding of cultural contact in early Roman Spain?*

In Chapter 1 we discussed the potential benefits of using LOD technologies in archaeological research. These potential benefits were resolved around five main themes: data processability and consumption, research sustainability, data interoperability, modelling flexibility and inferencing. This section expands upon the benefits and pitfalls encountered for each of the themes, including reflections considering the specific case study that we have focused on, to give answer to the research questions outlined in Chapter 1: *'To what extent is it possible to perceive the nature of the interaction between indigenous and Roman peoples through LOD technologies?* And *'What are the strengths and limitations of applying LOD technologies as a method for accessing, querying and analysing archaeological data?*

10.2.1. Data processability

The first potential benefit of LOD-implemented research mentioned in Chapter 1 is data processability and analysis. The prerequisite of allowing access to information and providing it in a non-proprietary format allows the automatic processing of data by the user. Traditional data management systems in archaeological research still present difficulties in terms of accessing and sharing information mostly related to the different formats in which the data is stored, and the limited access granted to the data. LOD technologies provide the user with direct access to non-proprietary data that can be printed, processed and stored locally for the user´s own purposes. This option delivers a huge freedom to the researcher who can manipulate the data without being obligated to follow the query system of any specific database interface. The benefits of this approach have been especially demonstrated in Chapter 8 with the possibilities of querying offered by the data provided by *EDH* and the limitations manifested by non-open access datasets.

Nevertheless, from the point of view of the user, the consumption of raw data from the web may require of the acquisition of certain technical skills which will depend, as in many other cases, of the amount of self-sufficiency that the researcher may want to gain in their capability to consume and process the information. There is no need to learn programming languages or SPARQL to consume and process LOD, however they can provide a better understanding of the schema and what this technology can or cannot do. This issue has been previously noted by Isaksen (2011), who underlined the necessity for technical alternatives more intuitive and familiar to the archaeologist. Since 2011, few tools have been generated to help the archaeologist in the process of data translation and integration with *Recogito being a notable exception*. As of March 2020, the appearance of new tools that spare the burden of learning programming languages or query languages seems to be a chimera. This research has demonstrated that, although using programming tools for the generation of RDF data adds complexity, it is recommended to create a more independence for the user and a better control and greater awareness of the data generation process.

The consumption of LOD from the web has also triggered the discussion of quality issues control issues, most of which have been addressed in section 4.4. Two of the main concerns regarding the quality of the data that this research has faced were related to existence of duplicated work and the quality and completeness of the data available online.

Data redundancy is one of the limitations that LOD is intended to eliminate. Because of this, it is a concern that one of the issues that has emerged when reusing LOD data is the repetition of information. The problem seems to be related to some extent with certain pre-conceptions regarding the generation of new resources. There seems to be certain reticence to reuse or consume data directly from the web whereas there is a wider acceptance of the projects that produce original tools or new data from scratch. These projects also tend to receive funding more easily since they are producing a new resource from scratch. The problem of data redundancy can be easily avoided by the use of cross-referencing and alignment between datasets, so this makes it an important concern for the LOD community.

Another of the limitations related to the consumption of data from the web is the incompleteness of the information. This concern has been mentioned in many cases throughout the thesis especially in chapter 6, when dealing with the problems of the epigraphic and geographic data consumed. The concern about incompleteness can be seen from two different perspectives: the user's concern in consuming incomplete data and the provider's concern to publish incomplete corpora. From the point of view of the user, incompleteness in archaeological datasets does not refer to the incompleteness of the record, which is inevitable to any archaeological system, but to the lack of integration of otherwise available information. Measures taken to solve this obstacle in ERUB included the integration of new data from already available web-exposed datasets that had not been integrated as LOD and written resources. It has been shown that although several resources claim to implement LOD technologies, this is not always entirely accomplished. Generally, the data is not provided as open access or some of the five-star criteria are not fulfilled. Issues like this can prevent the data consumption and delay the research process when wrong assumptions have been made. To avoid this sort of situations it is very important to review thoroughly the resources to be consumed.

From the point of view of the data publisher, the concern about making available incomplete corpora of data is still one of the main arguments raised in academia against the adoption of LOD standards. The fact that the data can be reused at an incomplete stage is not welcome in most of the cases. Regarding this issue, we have already referenced Tupman's work on this regard, that suggests not to avoid incompleteness, which is always going to be a component especially in archaeological research, but to document and represent such incompleteness in a way that can be asserted and potentially resolved in further contributions (Tupman forthcoming, section 2).

Finally, in regard of the incompleteness of data available, another issue that has been made apparent in this research is the visibility of the Roman world compared to local/indigenous material. One of the features shown by the data available from the resources online surveyed in this thesis, has been the interest shown by those resources in evidence related to the Roman world and the lesser interest shown towards the indigenous and local elements. This may be due to the large amount of research available regarding the Roman Empire, which could make data access and modelling easier, and also the fact that the Roman world is part of the cultural heritage of most European nations, providing therefore a common framework from which most of the countries can benefit. Projects working with local evidence are less numerous and always sponsored by domestic resources. This is not a problem confined to LOD, but it has introduced some bias in the research process that has been concerned with the integration of local data and is a significant issue to take into account for future research projects. The method shown in this research provides some ways to mitigate this problem.

10.2.2 Research sustainability

The availability of the data online in an accessible and operable way is also connected with another of the potential benefits outlined in chapter 1 which is the sustainability of the research produced and made available by LOD means. LOD can arguably achieve sustainability in research, not in terms of its survival on the web, since that only depends on the publisher having a means to guarantee its persistence, but in terms of the reutilisation of the information by others. It is important to bear in mind here that the publication of data online does not guarantee its survival and in some ways, it can in fact risk increasing their ephemerality by making their existence rely upon third parties. Nevertheless, the publication of authorised and licensed research in open access on the web allows its reutilisation by others. This facilitates new research being built upon already existing information which can be accessed and processed and not made from scratch.

In this sense, one of the limitations of publishing data on the web is the responsibilities it creates to ensure the sustainability and maintenance of the data. Decisions such as the domain of the URIs should be taken into account for the continued subsistence of the information. In the case of ERUB, the domain for the URIs was decided upon the final aim of the project, this being to make the data available at the open access data repository of the Open University (ORDO).

10.2.3 Data interoperability

Another potential benefit addressed in Chapter 1 was data interoperability. Once larger amounts of structured data are being made available online in standard formats, data can be linked by creating connections between different concepts, allowing greater interoperability between the information. This process requires an investment in data standardisation because semantic technologies require the publication of data in a standardised format. This is a pre-requisite for the implementation of LOD that can generate both certain benefits and limitations to the application of the method. Before the generation of ERUB, data had to be standardised and translated into RDF. Therefore, it was necessary to reflect upon the exiting vocabularies in order to find the best terminologies to describe the evidence in each of the different disciplines. In contrast to non-open relational databases, standardisation and cleaning of data is more significant when the information is going to be open access. This can provide certain benefits to the research flow as LOD motivates a major standardisation of the information to be later consumed and published in the Semantic Web as RDF. Nevertheless, the additional work that the standardisation that the standardisation requires, can also be demotivating in the addition of LOD methods. It is also worth noting here that any possible dataset may require some sort of standardisation before modelling the information in it, therefore LOD technologies do not pose especial limitations in this sense.

Within the question of data interoperability, the issue of data access and licensing also emerges. LOD requires data to be published as open access on the web: this in many cases can create certain concerns for the researcher who may fear accreditation of work might be lost in the LOD cloud and be consumed without proper referencing. It is important to acknowledge that the availability of the data online by no means implies that the data is not licensed or credited: in fact, LOD technologies encourage the consideration of data licensing and ownership, making it more important for the publisher to check and decide upon the licenses of the newly generated data, as well as the copyrights of the data that has been collected from other datasets.

The possibility of linking data from different resources allows cross-search queries over different data repositories through the so-called 'federated queries.' Federated queries allow the consultation of data contained in different repositories without the necessity to ingest them into a local store. The possibility of incorporating restricted-access data in Open Linked databases brings in new evidence that contextualises the original data and this could be an interesting development in archaeological research. Federated queries have been critically assessed in previous chapters as they constitute the optimal approach of LOD technologies by allowing access to several remote repositories through one single SPARQL endpoint. Nevertheless, their efficacy is still quite limited since the failure of one single endpoint can impede the whole querying process. Endpoints can fail due to temporary unavailability or limitation of the results obtained. Even so, there is also the tendency to put blocking operators in place to impede the federation. This happens because federated queries can grant the use of data and CPU power to external actors and this is not always very well received by data providers. Despite recent attempts to implement federated queries in archaeological research (see the aforementioned OpenArchaeo project) this approach has still not been implemented sufficiently, at least in the archaeological domain, therefore limiting the potential benefit of data interoperability outlined in chapter 1.

To avoid any problems of this kind, the data was ingested to be queried locally and aligned together with the newly generated data. In this way, the interoperability was achieved by the internal alignment of the datasets that relied on different mechanisms for the vocabularies used in the modelling as explained in chapter 6. It is important to note here that 5-stars LOD requires a significant investment in time and resources to link the newly generated data to other repositories available in the LOD cloud and this can demotivate such efforts in newly generated resources.

Finally, one of the main limitations that emerged in this research, linked to the interoperability of the data, is the poor visibility of new LOD resources published on the web. As aforementioned, there is very little guidance available on how to promote and disseminate LOD projects online. This issue is especially concerning for LOD technologies, since the interlinkage and collaboration between existing and newly created resources is one of their main aim and requisites of their efficiency. The topic has not yet received sufficient attention from the linked data community, particularly from published research or guidance on how better to leverage LOD resources and initiatives. In most cases, researchers resort to different media to promote projects obtaining different results. There is still the need to discuss the effectiveness of different strategies to raise awareness about LOD projects, which may include the development of a tentative protocol and perhaps a centralised resource as a demonstrator, to facilitate discoverability, interlinkage and alignment of new and existing resources.

10.2.4. Modelling flexibility

One of the main potential benefits offered by LOD is the flexibility provided by RDF that allows the modelling of any possible relationships between data items. In contrast to relational methods, RDF allows the representation of 'tree' data and hierarchical relationships between the entities. In addition, the use of URIs as subjects of the triples allows the easy aggregation of new information into the graph, thus making it easier to extend the structure of the database and the data contained.

In addition to the flexibility offered by the data framework, LOD also allows higher flexibility in the internal schema of the datasets by the use of ontologies. One of the best benefits of applying the method has been the opportunity to generate an ontology for cultural contact in antiquity. The development of this model produced a taxonomy of the different types of cultural contact perceived in the evidence, as well as other features involved in the cultural contact situations. This fact has had a fundamental impact on the research method and the understanding of the evidence within the model of cultural contact. CuCoO is an original contribution to the understanding of cultural contact in antiquity that can be used widely in modelling of cultural contact evidence in further disciplines and contexts.

As explained in Chapter 7, CuCoO is an ontology that allows the retrieval of cultural-enhanced data as an interconnected series of traits. As opposed to a catalogue or an index of objects which tend to present data in a linear format, CuCoO provided the possibility to model the ERUB dataset as an interconnected network of objects on the basis of common cultural features. To understand this functionality, we provided an example in chapter 7 related to the votive offering from Ituci Virtus Iulia (Torreparedones, Baena, Córdoba: Fig. 6.4. Object DJ030941). In contrast to the catalogue information provided by the museum database about the object in an indexed and linear way, the retrieval of data using the CuCoO model allows both the user and the data provider to go a step further in the way in which the data is stored, interconnected and retrieved.

LOD technologies allow the storage of the raw data as a set of interconnected items, that is, a graph dataset or knowledge graph of interrelated items that can be retrieved as interconnected knowledge. In this way, when querying ERUB for the data related to Object DJ030941 the results will consist of a small graph dataset that provides not only the tombstone data that can also be obtained from the catalogue but also the typified connections (predicates) that have been established between the statue and the rest of statements (objects). The fact that this information has been recorded in RDF using URIs as keys, facilitates the aggregation of new formation into the graph which can be expanded exponentially.

As explained above, the development of an ontology for cultural interaction as well as the description of the data in RDF has enabled the use of a complex level of semantics in the way the information was modelled and retrieved by the queries. At the same time, this allowed a higher level of granularity in the description of cultural contact evidence. In this way, the SPARQL queries run in Chapter 9 delivered those items collected in the database that displayed cultural traits associated with different cultural influences. This system provides a high level of description and retrieval of cultural contact evidence. Furthermore, this sort of reasoning allows the researcher not only to specify precise relationships between the objects and certain communities, but also to prove if such relationships can be systematically demonstrated by the data itself.

10.3. Results obtained from the application of LOD technologies to the study of cultural contact in early Roman southern Spain

This thesis has explored the case study of cultural interaction in early Roman Ulterior-Baetica employing a systematic approach to answer the research questions set out in Chapter 1 that relied on a) the generation of an LOD dataset, b) the implementation of a Cultural contact ontology and c) the SPARQL querying of the dataset and the analysis and comparison of the results.

Chapter 2 consisted of a review of the term ‘Romanisation’ and its use in European and especially Spanish scholarship, to demonstrate that the term is not valid in the chronological setting in which this investigation is focused. This led to a survey of the most recent approaches taken towards modelling cultural contact to assess its relevance to cultural processes that took place between indigenous and colonial communities in early Roman Spain. It was concluded that the cultural contact model offers a broader framework without presupposing cultural change in the context of cultural interaction.

Chapter 3 surveyed the current landscape of the study of cultural interaction in Ulterior-Baetica on the basis of the three types of evidence collected in ERUB: epigraphy, numismatics and sculpture. The latest studies of the epigraphy of the south of the peninsula were found to underline the importance of the Phoenician presence in the area that later merged with the Punic incursion. The numismatic evidence revealed the strong Phoeno-Punic presence in both coin legends and iconography making evident the complex cultural interplay that the coinage of Ulterior-Baetica reflected includes different iconographies and languages. Finally, the chapter also discussed the latest perspectives on the visual arts, giving special emphasis to the models of bilingualism and code-switching. These theories allow the reconsideration of sculptural objects not just as a form of aesthetics but also as a vehicle for the transmission of mixed codes of meaning.

Chapters 8 and 9 utilised semantic technologies to address the problems identified in Chapters 2 and 3. Chapter 8 analysed the question of epigraphic contact in early Roman southern Spain through a series of queries run on the ERUB dataset implementing CuCoO two examine two specific forms of evidence: onomastics and coin legends. The chapter provided a series of conclusions concerning the methodology and the two main research questions: *'How can cultural contact be perceived in onomastics?' and 'What different phenomena of linguistic contact are reflected in the coin legends?'*

How can cultural contact be perceived in onomastics?

This research has demonstrated that cultural contact can be perceived in the onomastic record of Ulterior-Baetica through querying across repositories for specific text-patterns and enriching the information returned with additional data. The results retrieved demonstrated that names of indigenous origin that display varied influences including Iberian, Greek, Etruscan and Punic and these can be modelled and retrieved in the data. The analysis of the epigraphic evidence provided by *EDH* has also demonstrated the need for a more exhaustive epigraphic ontology capable of recording more specific linguistic features in the texts such as the language, the script or the potential origin of the names recorded. Previous attempts to solve this issue were also discussed in Chapter 6 (e.g., EpiOnt ontology). And it clearly emerged that an epigraphic ontology would allow more systematic searches for specific linguistic phenomena such as indigenous onomastics recorded in Latin or bilingual texts without the need to rely on external sources.

What different phenomena of linguistic contact are reflected in the coin legends?

The results of the queries discussed in chapter 8 identified the four different languages used to record toponyms and authority names in the coin legends: Phoeno-Punic that later evolves in Neo-Punic, southern Iberian and Southern script, possibly Turdetanian recorded in Lybiophoenician script and Latin. In some of the mints, Latin appeared in combination with the other languages, however, the others were never combined with each other. Analytical query 6 retrieved a set of mints whose coins display any sort of linguistic variation. The exploration of the results identified different behaviours that indicate some sort of linguistic interaction in the mints. These include: 1) Latinisation of toponyms without a clear effect on metrology or the iconography; 2) the recording of the toponym in two different languages implying the desire two reach two different audiences; 3) adaptation of one language into another to record the names of individuals or, in some cases, possible indigenous magistracies involved in the minting process, for which we still do not have enough information to develop further conclusions.

Within the set of 'bilingual mints' a group known as 'Lybiophoenician mints' was especially interesting since they seem to combine a huge range of cultural influences not just in the choice of legends but also in the metrology and the iconography with its strong Punic influence in an area that was not previously considered as Punic lies beyond the hinterland of Gades.

Chapter 9, built upon the conclusions obtained in Chapter 8, further explored the question of iconographic contact in early Roman southern Spain through a series of queries run on the ERUB dataset. The main aim of the chapter was to explore the question of cultural contact in the visual material culture collected in ERUB related to coinage and the sculptural record by attempting to answer to questions: *'How is cultural contact related to the diffusion and adoption of iconographic types in the numismatic record?'* and *'How is cultural contact reflected in the different cultural influences that can be identified in the sculptural record?'*

How is cultural contact related to the diffusion and adoption of iconographic types in the numismatic record?

The results of the queries discussed in Chapter 9 identified permeable cultural contact as described by CuCoO. This sort of contact was perceived in the assimilation of the same iconographic types by certain groups of mints with geographical proximity and shared economic interests. This suggests that cultural contact in Ulterior-Baetica between indigenous and Roman groups in the first years of the Roman occupation seen in the numismatic record was generally driven by economic motives. The analysis also demonstrated that non-permeable cultural contact could be detected in other mints that suggest an interest in differentiation perhaps an assertion of political or economic independence.

How is cultural contact reflected in the different cultural influences that can be identified in the sculptural record?

Analysis in Chapter 9 helped to identify certain cultural influences on the visual media that traditional scholarship may have neglected in previous discourses. The SPARQL queries exploring the iconographic themes of the coins and the sculptural record enabled the identification of a concentration of cultural influences in the sculptures. Further exploration of the evidence for cultural contact identified certain connections between the iconography depicted on the coinage and the iconography of the sculptural repertoire of the province and associations with indigenous onomastics. Furthermore, the evidence for contacts seems to be concentrated in particular settlements, especially those that have a significant pre-Roman background. This is an observation that has not been previously explored.

10.4. Contributions and future work

In this last section, I would like to address certain concrete ways in which the work developed in this thesis may be carried forward.

1. Enrichment of ERUB dataset with evidence from more corpora: This research has demonstrated that archaeological data can be modelled as RDF and queried with

SPARQL to answer to a specific research question. However, from the beginning it was also apparent that the data collected in ERUB was incomplete. For future work I would suggest the enlargement of ERUB data with information derived from different corpora of evidence. One of the potential disciplines to start with would be pottery. The possibility of merging different archaeological datasets such as coinage, settlements, epigraphy and sculpture with the pottery records from the province of Ulterior-Baetica could bring new insights into the question of cultural contact. This would be a timely study since, at the time of this research, Kerameikos, a collaborative project for the definition of intellectual concepts for pottery following LOD standards, has recently become a fully functional data hub in the *Pelagios Network* project, incorporating 200 new vases from 5 data partners. There are no available LOD resources that can contribute pottery data from early Roman Spain and Kerameikos is still only oriented towards Greek pottery.

2. Enlargement of inference rules: Chapter 7 explained the process for building of the CuCoO ontology and the inference rules constructed by this research for the generation of new data from ERUB. These inference rules could not be taken further forward. An interesting implementation for further work might be the generation of new inference rules that could enrich other aspects of the ERUB dataset. One of the best sets of inference rules to develop in the future would be to incorporate linguistic information in the epigraphic data from EDH and other non-linked datasets such as Hesperia. Some attempts to generate inference rules on epigraphic data were experimentally developed in Chapter 8. Nevertheless, the queries proved to be very specific and the capacity to infer new data very limited.

For future work, it would be interesting to expand these experimental inference rules further to observe how the enrichment of data might provide new insights into the question of cultural contact in the epigraphic record. Another possibility for future research is the development of inference rules to enrich coinage data in terms of weight patterns of the coinage as well as iconography and epigraphy. This would allow the inferencing of larger amounts of data that could provide new coin-specific insights into traditional studies of metrology or mint iconography.

3. Extension of this research into other parts of Spain: at a very initial stage, this research was envisaged as a study of data from the entire Iberian Peninsula. Rapidly, it became obvious that it was necessary to narrow down the chronological and geographical scope of the main research question to address. Now this research has been completed, the proof of concept has been demonstrated and the methodology has been established, it would be possible to extend the geographic scale of the enquiry. Extending the research to other Roman provinces on the peninsula would enable comparison between patterns of cultural contact in different areas. Interprovincial comparison of cultural change using semantic technologies would create new ways of examining the phenomena that in the past where characterised as 'Romanisation'.

4. Expansion of the CuCoO ontology into other areas that have not been modelled: as was made clear over this investigation, the CuCoO ontology is by no means complete nor does it pretend to be the ultimate solution to understanding cultural contact in antiquity. Consequently, several aspects of the cultural contact process were left uncategorised and some aspects of cultural interaction dynamics were

left out of the modelling process. Future contributions could be focused on further implementation of the CuCoO ontology with the incorporation of new concepts to be modelled in the ontology to make it more comprehensive.

This research has proposed the application of a novel digital method to the study of cultural contact in the ancient world, specifically, the use of Linked Open Data technologies to identify mixed cultural traits across a range of archaeological evidence coming from early Roman southern Spain. The aim of the thesis has been the assessment of the methodology by the implementation of an original ontology (CuCoO) and the evaluation of the results retrieved from a set of queries in the fields of linguistic and iconographic contact.

In the assessment of the method, interesting conclusions have come to light regarding the main difficulties faced by non-technical experts to make available large amounts of data but also to make it interoperable and aligned with already existing resources. Other data quality concerns have been identified mainly related to the incompleteness of the data from the point of view of the user and the publisher, and the repetition of certain information. In the same way, interesting benefits of the method have been identified including the easy access, retrieval, processability and querying of the information, facilitating quantitative research and saving considerable amounts of time and effort in contrast to traditional research. Throughout this thesis, the main objective has never been to ‘overpraise’ this method and its benefits but to assess its applicability in daily archaeological practice.

In the development of this process, other conclusions have emerged in relation to the case study provided. Due to its nature, this research sits in a complex interdisciplinary setting, arising from the fields of archaeology, ancient history, art history and classical linguistics as well as web science, computational semantics and computer science. These fields come together in one newly emerging discipline: Digital Humanities. For these reasons, the work presented in this study should be considered as the product of a new generation of research that unites the application of state-of-the-art technologies with the exploration of research questions within fields that have a much longer trajectory of intellectual development.

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Appendix 1 Summary of Resources included in ERUB

Digital resources integrated in ERUB							
Resource	**URL**	**Responsibility**	**Format**	**License**	**Type of records integrated**	**Number of triples integrated**	**Description of content**
Pleiades	https://pleiades.stoa.org/	Institute for the Study of the Ancient World (TomElliot)	JSON, CSV, KML, TTL	CC-BY-CC	Settlements	16,653	Linked Open Geodata, information about settlements, time frames of occupation, names, geo location.
DARE	https://imperium.ahlfeldt.se/	Johan Åhlfeldt Department of Archaeology and Ancient History Lund University, Sweden	RDF, RDF/XML, JSON, GEO-JSON, KML	CC-BY-SA	Settlements	455,949	Linked Open Geodata, information about settlements, time frames of occupation, names, geo location.
Nomisma	http://nomisma.org/	American Numismatic Society	JSON-LD, TTL, RDF/XML	CC-BY	Mints	2,868	Coins, mints, numismatic concepts and places

Resource	URL	Responsibility	Format	License	Type of records integrated	Number of triples integrated	Description of content
EDH	https://edh-www.adw.uni-heidelberg.de/data	University of Heilderberg	GEOJSON, JOSN, TTL, XML	CC-BY-SA	Inscriptions	1,264,451	Epigraphic inscriptions from the Roman Empire and metadata

Digital Resources aligned						
Resource	**URL**	**Responsibility**	**Format**	**License**	**Number of URIs aligned**	**Description of content**
Pleiades	https://pleiades.stoa.org/	Institute for the Study of the Ancient World (TomElliot)	JSON, CSV, KML, TTL	CC-BY-CC	184 URIs	Linked Open Geodata, information about settlements, time frames of occupation, names, geo location.
DARE	https://imperium.ahlfeldt.se/	Johan Åhlfeldt Department of Archaeology and Ancient History Lund University, Sweden	RDF, RDF/XML, JSON, GEO-JSON, KML	CC-BY-SA	197 URIs	Linked Open Geodata, information about settlements, time frames of occupation, names, geo location.
Trismegistos	https://www.trismegistos.org/geo/index	University of Leuven	Epidoc XML, JSON	CC3	174 URIs	Geodata, epigraphic text and places.

Resource	URL	Responsibility	Format	License	Number of URIs aligned	Description of content
ARACHNE	https://arachne.dainst.org/	University of Colonne, German Archaeological Institute		CC-BY-NC -ND	47 URIs	Database of artistic and archaeological objects
CVB	http://cvb.vrbanitas.es/	Junta de Andalucía			86 URIs	Database with geodata and information about cities in two of the conventii of Ulterior Baetica
Domus	http://www.juntadeandalucia.es/cultura/WEBDomus/domus.do	Junta de Andalucía	PDF	Copyright	237 URIs	Online catalogue of museums in Andalucía objects in Andalusian collections and tombstone data
CERES	http://ceres.mcu.es/pages/SimpleSearch?index=true	Spanish Ministry of culture	PDF	Copyright	24 URIs	Online catalogue of Spanish museums, 316,000 records of objects in Spanish collections with tombstone data
IAPH	https://guiadigital.iaph.es/	Junta de Andalucía	PDF, JSON-LD		80 URIs	Database with more than 24,000 entities of archaeological, architectonic and ethnological heritage

Data generated ex novo				
Dataset	**Sources**	**Number of records integrated**	**Number of triples**	**Description of content**
Settlements	- De Bello Civili by Jiulius Caesar (50-40 BCE) - Naturalis historia by Pliny the Elder (74 CE). - Historia Lingüística de la Península Ibérica en la Antigüedad: I. Preliminares y el Mundo Meridional Prerromano (de Hoz 2010).	231 places	4023	Data about the settlements collected in ERUB: different names of the places along time, history of excavations, chronology of occupation, analysis of archaeological evidence, juridical status, cultural associations with other places and objects.
Sculptures	- Domus http://www.juntadeandalucia.es/cultura/WEBDomus/domus.do - Ceres http://ceres.mcu.es/pages/SimpleSearch?index=true	400 objects	6369	400 sculptures collected from the settlements recorded including measures, dates, description, iconographic depiction and context.
Scultpures data from inference rules	- ERUB data	500 inferences	4590	500 inferences based on cultural associations among sculptures and other items in the dataset

Dataset	Sources	Number of records integrated	Number of triples	Description of content
Coinage	- Diccionario de Cecas y Pueblos Hispánicos (M. Paz García-Bellido/Cruces Blázquez 2002) - Corpus Nummum Hispaniae Ante Augusti Aetatem, (Leandre Villaronga 1994)	616 coin types 1540 legends 77 mints	24881	Coin types: 616 coin-types extracted from the sources. Information about the coin type including mint, weight, label, denomination, chronology, findspot, material, and description of obverse and reverse. Legends: 1540 legends registered on coins with script, language, linguistic group and linguistic phenomena. Mints: 77 mints including location, dated of production, types of coins produced a long time, ethnic group, language.

Appendix 2: Visualisation of the results obtained from the SPARQL queries

Test query 1 in Nomisma: Obtain all the mints in Ulterior-Baetica. Provided by requesting all the mints within 200 km from Seville.

label	nomisma mint geospatial	latitude	longitude	nomisma mint id
Abdera	nm:abdera_hispania#this	36.733.333	-3.016.667	nm:abdera_hispania
Abra	nm:abra#this	37.765.419	-3.959.262	nm:abra
Acinippo	nm:acinippo#this	36.832.412	-5.240.746	nm:acinippo
Aipora	nm:aipora#this	36.779.174	-6.354.245	nm:aipora
Asido	nm:asido#this	36.467.791	-5.927.867	nm:asido
Baesuri	nm:baesuri#this	37.217.562	-7.445.494	nm:baesuri
Baicipo	nm:baicipo#this	362.698.828	-5.966.667	nm:baicipo
Bailo	nm:bailo#this	36.090.260	-5.774.433	nm:bailo
Balleia	nm:balleia#this	38.466.667	-6.166.667	nm:balleia
Balsa	nm:balsa#this	37.125.796	-7.649.884	nm:balsa
Baria	nm:baria	#############	#############	nm:baria
Bora	nm:bora#this	37.662.473	-4.039.839	nm:bora
Brutobriga	nm:brutobriga#this	38.974.054	-5.800.357	nm:brutobriga
Callet	nm:callet#this	37.052.305	-5.626.201	nm:callet
Carbula	nm:carbula#this	37.809.644	-5.019.918	nm:carbula
Carisa	nm:carisa#this	36.877.668	-5.732.101	nm:carisa
Carmo	nm:carmo#this	37.471.001	-5.642.257	nm:carmo
Carteia	nm:carteia#this	36.183.163	-5.410.359	nm:carteia
Caura	nm:caura#this	37.285.041	-6.051.830	nm:caura

label	nomisma mint geospatial	latitude	longitude	nomisma mint id
Cerit	nm:cerit#this	36.686.622	-6.137.337	nm:cerit
Ceuta	nm:ceuta#this	3.588.933	-531.979	nm:ceuta
Colonia Patricia	nm:colonia_patricia#this	37.884.683	-4.779.171	nm:colonia_patricia
Cordoba	nm:cordoba#this	3.789.155	-477.275	nm:cordoba
Corduba	nm:corduba#this	37.884.683	-4.779.171	nm:corduba
Cunbaria	nm:cunbaria#this	369.761.239	-59.834.719	nm:cunbaria
Ebura Cerealis	nm:ebura_cerealis#this	37.463.838	-3.916.667	nm:ebura_cerealis
Emerita	nm:emerita#this	38.916.159	-6.345.670	nm:emerita
Epora	nm:epora#this	38.026.033	-4.381.896	nm:epora
Gades	nm:gades#this	36.533.333	-6.288.596	nm:gades
Halos	nm:halos#this	37.166.667	-5.010.418	nm:halos
Hispalis	nm:hispalis#this	37.382.668	-5.996.293	nm:hispalis
Hispano-Punic	nm:hispano-punic#this	368.224.776	-61.578.369	nm:hispano-punic
Ilipense	nm:ilipense#this	37.518.215	-5.978.254	nm:ilipense
Ilipla	nm:ilipa#this	37.360.102	-6.679.208	nm:ilipa
Ilipla	nm:ilipla#this	37.360.102	-6.679.208	nm:ilipla
Ilse	nm:ilse#this	37.525.577	-6.157.627	nm:ilse
Ilurco	nm:ilurco#this	37.267.154	-3.767.231	nm:ilurco
Iptuci	nm:iptuci#this	36.789.695	-5.555.577	nm:iptuci
Irippo	nm:irippo#this	37.001.163	-5.391.451	nm:irippo
Ishbili/ah	nm:ishbili/ah#this	3.738.283	-597.317	nm:ishbili/ah
Italica	nm:italica#this	37.443.901	-6.046.795	nm:italica
Ituci	nm:ituci#this	37.448.110	-6.363.638	nm:ituci

label	nomisma mint geospatial	latitude	longitude	nomisma mint id
Julia Traducta	nm:julia_traducta#this	36.129.768	-5.447.744	nm:julia_traducta
Lacipo	nm:lacipo#this	36.443.331	-5.273.526	nm:lacipo
Laelia	nm:laelia#this	37.427.015	-6.165.904	nm:laelia
Lascuta	nm:lascuta#this	36.460.524	-5.723.687	nm:lascuta
Lastigi	nm:lastigi#this	37.523.585	-6.269.587	nm:lastigi
Madinat Sabtah	nm:madinat_sabtah#this	3.588.933	-531.979	nm:madinat_sabtah
Malaca	nm:malaca#this	36.716.667	-4.416.667	nm:malaca
Nabrisa	nm:nabrisa#this	36.919.504	-6.078.402	nm:nabrisa
Oba	nm:oba#this	36.434.053	-5.453.482	nm:oba
Obulco	nm:obulco#this	37.870.867	-4.184.754	nm:obulco
Olontigi	nm:olontigi#this	37.305.179	-6.248.394	nm:olontigi
Onuba	nm:onuba#this	37.257.074	-6.949.713	nm:onuba
Onuba	nm:onoba#this	37.257.074	-6.949.713	nm:onoba
Orippo	nm:orippo#this	37.283.163	-5.922.275	nm:orippo
Osset	nm:osset#this	37.358.375	-6.035.436	nm:osset
Ostur	nm:ostur#this	37.387.743	-6.429.457	nm:ostur
Pax Iulia	nm:pax_julia#this	38.015.604	-7.865.225	nm:pax_julia
Romula	nm:romula#this	37.382.668	-5.996.293	nm:romula
Sabtah	nm:sabtah#this	3.588.933	-531.979	nm:sabtah
Sacili	nm:sacili#this	38.005.797	-4.507.159	nm:sacili
Searo	nm:searo#this	37.052.397	-5.751.603	nm:searo
Seville	nm:seville#this	3.738.283	-597.317	nm:seville
Sisapo	nm:sisapo#this	38.645.383	-4.517.906	nm:sisapo
Tingis	nm:tingis#this	35.787.924	-5.810.048	nm:tingis

label	nomisma mint geospatial	latitude	longitude	nomisma mint id
Ulia	nm:ulia#this	37.648.657	-4.698.889	nm:ulia
Urso	nm:urso#this	37.236.984	-5.102.780	nm:urso
Ventipo	nm:ventipo#this	37.293.890	-4.759.548	nm:ventipo

Test query 2 in Pleiades: retrieve settlements, descriptions, names, dates and geographical coordinates.

settlement name	settlement id	description	start_date	end_date	latitude	longitude
pleiades:265762/abdara	pleiades:265762	An ancient place, cited: BAtlas 27 B5 Abdera	-750	640	36.748.068	-3.022.514
pleiades:265762/abdera	pleiades:265762	An ancient place, cited: BAtlas 27 B5 Abdera	-750	640	36.748.068	-3.022.514
pleiades:255950/acinippo	pleiades:255950	An ancient place, cited: BAtlas 26 E5 Acinippo	-330	300	36.832.168	-52.403.014
pleiades:265771/ad-gemellas	pleiades:265771	An ancient place, cited: BAtlas 27 A4 Ad Gemellas?	-30	640	37.267.334	-4.540.411
pleiades:255953/ad-herculem	pleiades:255953	An ancient place, cited: BAtlas 26 D5 Ad Herculem	-30	640	36.351.621	-6.163.431
pleiades:265773/ad-lucos	pleiades:265773	An ancient place, cited: BAtlas 27 A4 Ad Lucos	-330	300	3.802.053	-4.403.644
pleiades:255956/ad-rubras	pleiades:255956	An ancient place, cited: BAtlas 26 D4 Ad Rubras	-30	640	37.271.136	-7.021.606
pleiades:265784/acatucci	pleiades:265784	An ancient place, cited: BAtlas 27 B4 Agatucci?	-30	640	37.591.727	-31.811
pleiades:265784/agatucci	pleiades:265784	An ancient place, cited: BAtlas 27 B4 Agatucci?	-30	640	37.591.727	-31.811
pleiades:265785/aiungi	pleiades:265785	An ancient place, cited: BAtlas 27 A4 Aiungi	-330	300	37.591.065	-4.086.744
pleiades:265785/respublica-aiungitanorum	pleiades:265785	An ancient place, cited: BAtlas 27 A4 Aiungi	-330	300	37.591.065	-4.086.744
pleiades:265785/respublica-aiungitanrum	pleiades:265785	An ancient place, cited: BAtlas 27 A4 Aiungi	-330	300	37.591.065	-4.086.744
pleiades:265799/anticaria	pleiades:265799	An ancient Roman town mentioned in the Antonine Itinerary and by the Ravenna Cosmographer. Modern Antequera in Spain.	-30	640	37.019.374	-4.562.887
pleiades:265801/aratispi	pleiades:265801	An ancient place, cited: BAtlas 27 A5 Aratispi	-30	640	369.384.218	-44.411.843
pleiades:265801/rataspem	pleiades:265801	An ancient place, cited: BAtlas 27 A5 Aratispi	300	640	369.384.218	-44.411.843
pleiades:256159/arsa	pleiades:256159	An ancient place, cited: BAtlas 26 E5 Erisane/Arsa	-330	640	36.512.531	-5.913.705

settlement name	settlement id	description	start_date	end_date	latitude	longitude
pleiades:256159/erisane	pleiades:256159	An ancient place, cited: BAtlas 26 E5 Erisane/Arsa	-330	-30	36.512.531	-5.913.705
pleiades:255990/artigi	pleiades:255990	An ancient place, cited: BAtlas 26 E3 Artigi	-330	640	38.722.599	-5.545.601
pleiades:255991/arucci	pleiades:255991	An ancient place, cited: BAtlas 26 C4 Arucci	-30	640	37.963.738	-713.148
pleiades:255992/arunda	pleiades:255992	An ancient place, cited: BAtlas 26 E5 Arunda	-30	300	3.674.194	-5.166.408
pleiades:255993/arva	pleiades:255993	An ancient place, cited: BAtlas 26 E4 Arva	-30	300	37.614.173	-5.671.303
pleiades:255994/asido	pleiades:255994	An ancient place, cited: BAtlas 26 E5 Asido	-330	640	36.467.791	-5.927.867
pleiades:255994/asido-caesarina	pleiades:255994	An ancient place, cited: BAtlas 26 E5 Asido	-330	640	36.467.791	-5.927.867
pleiades:256193/asta	pleiades:256193	An ancient town near Jerez de la Frontera, which belonged to the Conventus Hispalensis.	-750	640	36.788.002	-6.172.572
pleiades:256193/col-hasta-regia	pleiades:256193	An ancient town near Jerez de la Frontera, which belonged to the Conventus Hispalensis.	-750	-550	36.788.002	-6.172.572
pleiades:256193/hasta	pleiades:256193	An ancient town near Jerez de la Frontera, which belonged to the Conventus Hispalensis.	-750	640	36.788.002	-6.172.572
pleiades:255996/astigi	pleiades:255996	Now the modern Ecija on the Genil river, Astigi was the capital of one of the four conventus of Baetica and became an Augustan colony after 27 B.C.	-330	640	37.540.932	-5.079.949
pleiades:255996/col-augusta-firma	pleiades:255996	Now the modern Ecija on the Genil river, Astigi was the capital of one of the four conventus of Baetica and became an Augustan colony after 27 B.C.	-330	640	37.540.932	-5.079.949
pleiades:255996/name.2016-11-23.5857028617	pleiades:255996	Now the modern Ecija on the Genil river, Astigi was the capital of one of the four conventus of Baetica and became an Augustan colony after 27 B.C.	640	1453	37.540.932	-5.079.949
pleiades:255996/name.2016-11-23.8199789413	pleiades:255996	Now the modern Ecija on the Genil river, Astigi was the capital of one of the four conventus of Baetica and became an Augustan colony after 27 B.C.	1700	2100	37.540.932	-5.079.949
pleiades:265810/aurgi	pleiades:265810	An ancient place, cited: BAtlas 27 B4 Aurgi/Orongis	-330	640	37.791.929	-3.808.119

settlement name	settlement id	description	start_date	end_date	latitude	longitude
pleiades:265810/auringis	pleiades:265810	An ancient place, cited: BAtlas 27 B4 Aurgi/Orongis	-330	640	37.791.929	-3.808.119
pleiades:265810/orongis	pleiades:265810	An ancient place, cited: BAtlas 27 B4 Aurgi/Orongis	-330	640	37.791.929	-3.808.119
pleiades:256002/axati	pleiades:256002	An ancient place, cited: BAtlas 26 E4 Axati	-30	300	37.659.304	-5.526.244
pleiades:256004/baedro	pleiades:256004	An ancient place, cited: BAtlas 26 E3 Baedro	-30	300	38.501.008	-514.839
pleiades:256005/baelo	pleiades:256005	B(a)elo is located on the northern shore of the Strait of Gibraltar. The town was founded by the late second century BC and achieved municipal status under Claudius.	-30	640	3.609.026	-5.774.433
pleiades:256005/baldo	pleiades:256005	B(a)elo is located on the northern shore of the Strait of Gibraltar. The town was founded by the late second century BC and achieved municipal status under Claudius.	-330	-30	3.609.026	-5.774.433
pleiades:256005/bardo	pleiades:256005	B(a)elo is located on the northern shore of the Strait of Gibraltar. The town was founded by the late second century BC and achieved municipal status under Claudius.	-330	-30	3.609.026	-5.774.433
pleiades:256005/belo	pleiades:256005	B(a)elo is located on the northern shore of the Strait of Gibraltar. The town was founded by the late second century BC and achieved municipal status under Claudius.	-30	640	3.609.026	-5.774.433
pleiades:256005/belon	pleiades:256005	B(a)elo is located on the northern shore of the Strait of Gibraltar. The town was founded by the late second century BC and achieved municipal status under Claudius.	-30	300	3.609.026	-5.774.433
pleiades:256007/baesippo	pleiades:256007	An ancient place, cited: BAtlas 26 E5 Baesippo	-30	640	36.192.554	-591.903
pleiades:256453/barla	pleiades:256453	Singilia Barba was the site of a Roman municipium near Antequera, Málaga, Spain.	-30	300	37.032.488	-4.630.364
pleiades:256453/singili-barba	pleiades:256453	Singilia Barba was the site of a Roman municipium near Antequera, Málaga, Spain.	-30	640	37.032.488	-4.630.364

settlement name	settlement id	description	start_date	end_date	latitude	longitude
pleiades:256453/singilia-barba	pleiades:256453	Singilia Barba was the site of a Roman municipium near Antequera, Málaga, Spain.	-30	640	37.032.488	-4.630.364
pleiades:256017/bamaliana	pleiades:256017	An ancient place, cited: BAtlas 26 E5 Barbesula/Barbariana?	300	640	36.296.985	-5.272.343
pleiades:256017/barbariana	pleiades:256017	An ancient place, cited: BAtlas 26 E5 Barbesula/Barbariana?	-30	640	36.296.985	-5.272.343
pleiades:256017/barbesula	pleiades:256017	An ancient place, cited: BAtlas 26 E5 Barbesula/Barbariana?	-30	640	36.296.985	-5.272.343
pleiades:256020/basilippo	pleiades:256020	An ancient place, cited: BAtlas 26 E4 Basilippo	-30	640	37.264.098	-554.279

Test query 3 in ERUB : retrieve 50 settlements from ERUB.

erub id for settlement
erub/settlement/abdera/1" ,
erub/settlement/abra/2" ,
erub/settlement/acci/3" ,
erub/settlement/acinippo/4" ,
erub/settlement/ad_aras/5" ,
erub/settlement/ad_decumo_1/6" ,
erub/settlement/ad_decumo_2/7" ,
erub/settlement/ad_gemellas/8" ,
erub/settlement/ad_herculem/9" ,
erub/settlement/ad_lucos/10" ,
erub/settlement/ad_noulas/11" ,
erub/settlement/ad_pontem/12" ,
erub/settlement/ad_rubras/13" ,
erub/settlement/adamuz/14" ,
erub/settlement/agatucci/15" ,
erub/settlement/aipora/16" ,
erub/settlement/aiungi/17" ,
erub/settlement/alba/18" ,
erub/settlement/albus_portus/19" ,
erub/settlement/anticaria/20" ,
erub/settlement/aratispi/21" ,
erub/settlement/arsa/22" ,
erub/settlement/artigi/23" ,

erub id for settlement
erub/settlement/arucci/24" ,
erub/settlement/arunda/25" ,
erub/settlement/arva/26" ,
erub/settlement/asido/27" ,
erub/settlement/asso/28" ,
erub/settlement/asta_regia/29" ,
erub/settlement/astigi/30" ,
erub/settlement/ategua/31" ,
erub/settlement/aurgi/32" ,
erub/settlement/axati/33" ,
erub/settlement/baedro/34" ,
erub/settlement/baesuri/35" ,
erub/settlement/baicipo_(baesippo)/36" ,
erub/settlement/bailo_(baelo_claudia)/37" ,
erub/settlement/balleia/38" ,
erub/settlement/balsa/39" ,
erub/settlement/barba/40" ,
erub/settlement/barbariana_barbesula/41" ,
erub/settlement/baria/42" ,
erub/settlement/basilippo/43" ,
erub/settlement/basti/44" ,
erub/settlement/batora/45" ,
erub/settlement/begastrum/46" ,
erub/settlement/bora/47" ,
erub/settlement/brutobriga/48" ,

erub id for settlement
erub/settlement/caepionis_turris/49" ,
erub/settlement/caetaria/50" ,

Analytical query 1: Oldest inscriptions in EDH with geographical reference.

inscription	Start Date	End Date	place	label	latitude	longitude	text
edh/inschrift:hd029195	-130	-71	edh/geographie:2818	Corduba Córdoba Camino Claudio Marcelo	3.788.333	-476.667	[---?]AL[---]
edh/inschrift:hd003581	-100	-1	edh/geographie:2774	Italica Santiponce Avenida de Extremadura 56	3.743.553	-604.106	M(arcus) Trahius C(ai) f(ilius) pr(aetor?) AP[---] / de stipe idemq(ue) cavi[las? ---]
edh/inschrift:hd030584	-100	-1	edh/geographie:2438	Iliberri Florentia? Granada?	37.176.487	-3.597.929	Asanan
edh/inschrift:hd047484	-100	-51	edh/geographie:2723	Carissa Aurelia, bei Villamartín	36.862.592	-5.645.256	C(aio) Memmio [- f(ilio)] / imperato[ri ------
edh/inschrift:hd016474	-79	-76	edh/geographie:2195	Municipium Flavium V(---), bei Azuaga, bei	38.264.063	-5.680.618	Q(uinti) Me(telli)
edh/inschrift:hd029699	-79	-76	edh/geographie:2195	Municipium Flavium V(---), bei Azuaga, bei	38.264.063	-5.680.618	Q(uinti) M(etelli)
edh/inschrift:hd016501	-71	130	edh/geographie:2345	Corduba Córdoba	3.788.333	-476.667	Satur mur(millo) Iul(iani) XIII / Bassus l(iberatus) mur(millo) I |(coronae) I / h(ic) s(iti) s(unt) s(it) v(obis) t(erra) l(evis) / Cornelia Severa / uxor d(e) s(uo) d(edit)
edh/inschrift:hd000996	-51	14	edh/geographie:2573	Iliturgi Mengíbar, bei	37.969.237	-3.808.823	Ti(berio) Sempronio Graccho / deductori / populus Iliturgitanus
edh/inschrift:hd002844	-51	50	edh/geographie:2745	Astigi, bei Écija, bei	37.540.931.999	-5.079.949	Ephapra / Pacciorum / [------
edh/inschrift:hd004193	-50	1	edh/geographie:2836	Mellaria, bei Fuente Obejuna Camino de los Palos, südl. Begrenzungsmauer, sekundär verwendet	3.826.667	-541.667	Puel(l)a M(arci)(?) f(ilia)(?) Licini[ani?]

inscription	Start Date	End Date	place	label	latitude	longitude	text
edh/inschrift:hd003839	-50	30	edh/geograpahie:2538	Baedro, bei Los Pedroches	3.869.986	-492.622	[------?] / [---]ius hic / [situs est?]
edh/inschrift:hd026623	-50	-1	edh/geograpahie:2345	Corduba Córdoba	3.788.333	-476.667	T(itus) noster / Fausta Fausti / Pollio filius // Casius / Clipius(?) / Munnitia
edh/inschrift:hd028067	-50	30	edh/geograpahie:2345	Corduba Córdoba	3.788.333	-476.667	Genio
edh/inschrift:hd028229	-50	30	edh/geograpahie:3185	Corduba Córdoba Sta. Marina, Pfarrei	3.788.333	-476.667	T(itus) Acclenus T(iti) f(ilius) Qui(rina) cent(urio?) / Annia T(iti) l(iberta) Helena uxor / frugi summa qum probitate / fide magna concordes indigne / morbo excruciati morte obierunt / D(ecimus) Vergilius Amarantus a(nnorum) LXXX
edh/inschrift:hd029038	-50	50	edh/geograpahie:2567	Tucci Martos	3.772.107	-397.264	Celsidii
edh/inschrift:hd030596	-50	-1	edh/geograpahie:2284	Ilurco Cerro de los Infantes	37.267.153.999	-3.767.231.000	P(ublius) Iuni(us) Bo(---) f(ilius?)
edh/inschrift:hd031544	-50	-1	edh/geograpahie:2619	Urso Osuna	3.723.765	-510.746	C(aius) Vettius C(ai) f(ilius) Ser(gia) / centur(io) leg(ionis) XXX / IIvir iterum / G(enio) c(oloniae) G(enetivae) Iul(iae) sacrum dat
edh/inschrift:hd031565	-50	-1	edh/geograpahie:3256	Urso Osuna calle Granada, bei	3.723.765	-510.746	M(arcus) Aemilie[nus f(ilius)] / d(ecurionum) f(aciendum) c(uravit)
edh/inschrift:hd052736	-50	-1	edh/geograpahie:2243	Carmo, bei Carmona, bei	37.479.217	-5.646.973	Dis inferis vos rogo utei(!) recipiates(!) nomen / Luxsia A(uli) Antesti filia caput cor cos[i]lio(m!) valetudine(m) / vita(m) membra omnia accedat morbo cotidea(!) et / sei(!) faciatis votum quod faccio(!) solva(m) vostris(!) meretis(!)

inscription	Start Date	End Date	place	label	latitude	longitude	text
edh/inschrift:hd004001	-49	-49	edh/geograpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609.064	-4.741.201	L(ucio) Lentulo C(aio) Marcello co(n)s(ulibus) / Q(uinto) Cassio C(ai) f(ilio) Long(ino) tr(ibuno) pl(ebis) pro pr(aetore) / Binsnes Vercellonis f(ilius) Xvir maxs(umus)(!) / M(arcus) Coranus Acrin(i) f(ilius) Alpis / aedilis portam faciund(am) / coer(averunt) [d]e sua pecun(ia)
edh/inschrift:hd000936	-45	-45	edh/geograpahie:2892	Carteia El Rocadillo Cortijo de El Rocadillo; casa de Torre Cartagena	36.183.163	-5.410.358.999	M(arcus) Petrucidius M(arci) f(ilius) / leg(atus) pro pr(aetore) M(arcus) Lici(nius)
edh/inschrift:hd029983	-45	-45	edh/geograpahie:2688	Ategua Córdoba Santa Cruz, {Teba la Vieja}	37.755.207.377	-4.572.926.759	Cn(aei) Mag(ni)
edh/inschrift:hd029986	-45	-45	edh/geograpahie:2688	Ategua Córdoba Santa Cruz, {Teba la Vieja}	37.755.207.377	-4.572.926.759	[Cn(aei)] Mag(ni) imp(eratoris)
edh/inschrift:hd029989	-45	-45	edh/geograpahie:2688	Ategua Córdoba Santa Cruz, {Teba la Vieja}	37.755.207.377	-4.572.926.759	Cn(aei) Mag(ni) // imp(eratoris)
edh/inschrift:hd031388	-45	-45	edh/geograpahie:2256	Ostippo, bei Castillo de Alhonoz, bei	37.291.477.999	-4.878.530.999	AVTE
edh/inschrift:hd031733	-45	-45	edh/geograpahie:2620	Urso, bei Osuna, bei	37.236.970	-5.102.748	Cn(aei) Mag(ni) // imp(eratoris)
edh/inschrift:hd031742	-45	-45	edh/geograpahie:2619	Urso Osuna	3.723.765	-510.746	AVE
edh/inschrift:hd029192	-31	30	edh/geograpahie:2345	Corduba Córdoba	3.788.333	-476.667	Ob / ciivis(!) / ser(vatos)
edh/inschrift:hd001008	-30	30	edh/geograpahie:2619	Urso Osuna	3.723.765	-510.746	Argentaria L(uci) l(iberta) / Euc(h)erea sibi et / L(ucio) Argentario / Pamp(h)ilo viro / [s]uo et patrono

inscription	Start Date	End Date	place	label	latitude	longitude	text
edh/inschrift:hd002056	-30	30	edh/geograpahie:2750	Siarum La Cañada En las márgenes del pantano del Águila""	37.056.338	-5.752.384	Gn(aeo) Servilio Gn(aei) f(ilio) / Gal(eria) Nigro IIvir(o) / interregi
edh/inschrift:hd002856	-30	14	edh/geograpahie:2743	Astigi Écija	375.422	-50.826	[-] Lucilius / L(uci) f(ilius) Pap(iria)
edh/inschrift:hd003253	-30	30	edh/geograpahie:2777	Corduba Córdoba Avenida del Gran Capitán	3.788.333	-476.667	M(arcus) Latinius M(arci) [l(ibertus)? ---] / L(ucius) Afinius L(uci) l(ibertus) Ata[---] / Latinia M(arci) l(iberta) T[---] / Demetrius fi[lius] / Latinia M(arci) l(iberta) Da[---] / sarcinatrix [---?]
edh/inschrift:hd004160	-30	30	edh/geograpahie:2398	Ucubi Espejo	37.679.276	-4.553.744.999	[------?] / Helvia E(?)[---] / X(?)[---]
edh/inschrift:hd010992	-30	14	edh/geograpahie:3340	Ipagrum, bei Puente Genil, bei cortijo del Lagar de S. Francisco	37.515.020.999	-4.656.038.999	Aecia / Q(uinti) l(iberta) Nice / l(ocus) p(edum) XV
edh/inschrift:hd011239	-30	30	edh/geograpahie:2878	Corduba Córdoba Convento de la Merced	3.788.333	-476.667	M(arcus) Aerarius soc(iorum) aerar(iorum) l(ibertus) / Telemac(h)us medicus / hic quiescit vale
edh/inschrift:hd016528	-30	14	edh/geograpahie:2832	Corduba Córdoba Camino Viejo de Almodóvar	3.788.333	-476.667	L(ocus) p(edum) XII / [M]amilia M(arci) f(ilia)
edh/inschrift:hd017015	-30	14	edh/geograpahie:2220	Igabrum Cabra	37.474.366	-4.425.931	M(arcus) Fabius M(arci) l(ibertus) Ausua / sibei(!) matri fratribus / Fabia mater / M(arcus) Fabius Decumus / M(arcus) Fabius M(arci) l(ibertus) Balb[i]n(us) / M(arcus) Fabius Antiatis l(ibertus) Medianus / M(arcus) Fabius Antiatis l(ibertus) Seneca

inscription	Start Date	End Date	place	label	latitude	longitude	text
edh/inschrift:hd017491	-30	30	edh/geogrpahie:3046	Iliturgi Mengíbar, bei Las Torres	37.969.237	-3.808.823	------] / [[[------]]] / [---]que ero quo[---] / [---]e nostro lib[---] / [---q]uosque aliter [---] / [---]os esse cognove[r---] / [---]iculum impensa [---] / [---]o meosque libero[s ---] / [---]m poterunt per ae[---] / [---] numen eius viola[verit ---] / [--- M]aximus Dique Pena[tes ---] / [---om]nique fortuna fa[ciant ---]
edh/inschrift:hd026620	-30	1	edh/geogrpahie:2345	Corduba Córdoba	3.788.333	-476.667	Dionisia(!) Denatiai(!) / ancilla rogat deibus(!) ego / rogo bono bono / deibus(!) rogo oro bono / einfereis(!) bono Salpina / rogo oro et bonis inferis / ut dioso(!) quod fit deibus(!) / inferabus(!) ut hoc quo(d) sit / causa et ecquod votum / feci ut solva(t) rogo / ut illam ducas(!) rogo / oro
edh/inschrift:hd026626	-30	1	edh/geogrpahie:2345	Corduba Córdoba	3.788.333	-476.667	C(aius) Nu(misius) Sex[to?] / C(aius) Num(isius) P(h)ilem[on] / Num(isia) (H)era[cli]a / Calipso Num(isiorum) / C(aia) Avilia Ir[e]na / C(aius) Num(isius) Epa[p(h)]rodi[tu]s / C(aius) Num(isius) Ae[s]c(h)inus / Scinti[ll]a Num(isiorum)

Analytical query 2: Oldest inscriptions in EDH from Torreparedones dating between 2nd – 1st century BCE.

inscription	startDate	endDate	support	support	script	text
edh/inschrift:hd029728	-0030	-0001	edh/type_of_monument:urn			M(arcus) Pompeius Q(uinti) f(ilius) Gal(eria) Icstnis / IIvir primus de familia / Pompeia
edh/inschrift:hd029731	-0030	-0001	edh/type_of_monument:urn			Fabia M(arci) f(ilia) Aninna / M(arci) Pompei Q(uinti) f(ili)
edh/inschrift:hd029734	-0030	-0001	edh/type_of_monument:urn			Q(uinti) Pompei Q(uinti) f(ili) Sabini
edh/inschrift:hd029737	-0030	-0001	edh/type_of_monument:urn			Pompeiae Q(uinti) f(iliae) / Nannae
edh/inschrift:hd029740	-0030	-0001	edh/type_of_monument:urn			Q(uintus) Pompeius Q(uinti) f(ilius) / Velaunis
edh/inschrift:hd029743	-0030	-0001	edh/type_of_monument:urn			Ildrons / Velaunis f(ilius)
edh/inschrift:hd029746	-0030	-0001	edh/type_of_monument:urn			Igalghis Ildrons f(ilius)
edh/inschrift:hd029749	-0030	-0001	edh/type_of_monument:urn			Gracchi
edh/inschrift:hd029752	-0030	-0001	edh/type_of_monument:urn			Iunia L(uci) f(ilia) / Insghana
edh/inschrift:hd029755	-0030	-0001	edh/type_of_monument:urn			Sisean Bahan/nonis f(ili-)
edh/inschrift:hd029758	-0030	-0001	edh/type_of_monument:urn			Velgana
edh/inschrift:hd029761	-0030	-0001	edh/type_of_monument:urn			Cn(aeus) Pompeius Cn(aei) f(ilius) / Gal(eria) Afer aed(ilis) / IIvir
erub/sculpture/ituci_virtus_iulia/dj030941/inscription	-200	-100	erub/sculpture/ituci_virtus_iulia/dj030941	bm/id/thesauri/language/latin	bm/id/thesauri/Script/latin	DEA CAEL (estis) IVS (sit)
erub/sculpture/ituci_virtus_iulia/dj030942/inscription	-200	-100	erub/sculpture/ituci_virtus_iulia/dj030942	bm/id/thesauri/language/latin	bm/id/thesauri/Script/latin	N - AGALEAMCRETIANO ;

Analytical query 3: Personal names recorded in the earliest inscriptions in Ulterior-Baetica.

inscription	person	startDate	endDate	place	label	latitude	longitude	name
edh/inschrift: hd003581	edh/person:hd003581/1	-0100	-0001	edh/geogrpahie:2774	Italica Santiponce Avenida de Extremadura 56	37.43553	-6.04106	M. Trahius
edh/inschrift: hd030584	edh/person:hd030584/1	-0100	-0001	edh/geogrpahie:2438	Iliberri Florentia? Granada?	37.176487	-3.597929	Asanan
edh/inschrift: hd016474	edh/person:hd016474/1	-0079	-0076	edh/geogrpahie:2195	Municipium Flavium V(---), bei Azuaga, bei	38.264063	-5.680618	Q. Metellus
edh/inschrift: hd029699	edh/person:hd029699/1	-0079	-0076	edh/geogrpahie:2195	Municipium Flavium V(---), bei Azuaga, bei	38.264063	-5.680618	Q. Metellus
edh/inschrift: hd016501	edh/person:hd016501/2	-0071	0130	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Bassus
edh/inschrift: hd016501	edh/person:hd016501/3	-0071	0130	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Cornelia Severa
edh/inschrift: hd016501	edh/person:hd016501/1	-0071	0130	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Satur
edh/inschrift: hd002844	edh/person:hd002844/1	-0051	0050	edh/geogrpahie:2745	Astigi, bei Écija, bei	37.540931999	-5.079949	Ephapra (= Epaphra)
edh/inschrift: hd002844	edh/person:hd002844/2	-0051	0050	edh/geogrpahie:2745	Astigi, bei Écija, bei	37.540931999	-5.079949	Paccii
edh/inschrift: hd000996	edh/person:hd000996/1	-0051	0014	edh/geogrpahie:2573	Iliturgi Mengíbar, bei	37.969237	-3.808823	Ti. Sempronius Gracchus
edh/inschrift: hd029038	edh/person:hd029038/1	-0050	0050	edh/geogrpahie:2567	Tucci Martos	37.72107	-3.97264	Celsidius
edh/inschrift: hd026623	edh/person:hd026623/5	-0050	-0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Casius

inscription	person	startDate	endDate	place	label	latitude	longitude	name
edh/inschrift: hd026623	edh/person:hd026623/6	-0050	-0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Clipius
edh/inschrift: hd026623	edh/person:hd026623/2	-0050	-0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Fausta
edh/inschrift: hd026623	edh/person:hd026623/3	-0050	-0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Faustus
edh/inschrift: hd026623	edh/person:hd026623/7	-0050	-0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Munnitia
edh/inschrift: hd026623	edh/person:hd026623/4	-0050	-0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Pollio
edh/inschrift: hd026623	edh/person:hd026623/1	-0050	-0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Titus
edh/inschrift: hd031565	edh/person:hd031565/1	-0050	-0001	edh/geogrpahie:3256	Urso Osuna calle Granada, bei	37.23765	-5.10746	M. Aemilienus
edh/inschrift: hd004193	edh/person:hd004193/2	-0050	0001	edh/geogrpahie:2836	Mellaria, bei Fuente Obejuna Camino de los Palos, südl. Begrenzungsmauer, sekundär verwendet	38.26667	-5.41667	Licinianus ?
edh/inschrift: hd004193	edh/person:hd004193/1	-0050	0001	edh/geogrpahie:2836	Mellaria, bei Fuente Obejuna Camino de los Palos, südl. Begrenzungsmauer, sekundär verwendet	38.26667	-5.41667	Puella
edh/inschrift: hd028229	edh/person:hd028229/2	-0050	0030	edh/geogrpahie:3185	Corduba Córdoba Sta. Marina, Pfarrei	37.88333	-4.76667	Annia Helena
edh/inschrift: hd028229	edh/person:hd028229/3	-0050	0030	edh/geogrpahie:3185	Corduba Córdoba Sta. Marina, Pfarrei	37.88333	-4.76667	D. Vergilius Amarantus
edh/inschrift: hd028229	edh/person:hd028229/1	-0050	0030	edh/geogrpahie:3185	Corduba Córdoba Sta. Marina, Pfarrei	37.88333	-4.76667	T. Acclenus
edh/inschrift: hd030596	edh/person:hd030596/1	-0050	-0001	edh/geogrpahie:2284	Ilurco Cerro de los Infantes	37.267153999	-3.767231000	P. Iunius Bo(---)

inscription	person	startDate	endDate	place	label	latitude	longitude	name
edh/inschrift: hd031544	edh/person:hd031544/1	-0050	-0001	edh/geogrpahie:2619	Urso Osuna	37.23765	-5.10746	C. Vettius
edh/inschrift: hd003839	edh/person:hd003839/1	-0050	0030	edh/geogrpahie:2538	Baedro, bei Los Pedroches	38.69986	-4.92622	[---]ius
edh/inschrift: hd004001	edh/person:hd004001/7	-0049	-0049	edh/geogrpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609064	-4.741201	Acrinus
edh/inschrift: hd004001	edh/person:hd004001/4	-0049	-0049	edh/geogrpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609064	-4.741201	Binsnes
edh/inschrift: hd004001	edh/person:hd004001/2	-0049	-0049	edh/geogrpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609064	-4.741201	C. Marcellus
edh/inschrift: hd004001	edh/person:hd004001/1	-0049	-0049	edh/geogrpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609064	-4.741201	L. Lentulus
edh/inschrift: hd004001	edh/person:hd004001/6	-0049	-0049	edh/geogrpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609064	-4.741201	M. Coranus Alpis
edh/inschrift: hd004001	edh/person:hd004001/3	-0049	-0049	edh/geogrpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609064	-4.741201	Q. Cassius Longinus
edh/inschrift: hd004001	edh/person:hd004001/5	-0049	-0049	edh/geogrpahie:3014	Sabetum? La Rambla Kaserne der Guardia Civil	37.609064	-4.741201	Vercello
edh/inschrift: hd029983	edh/person:hd029983/1	-0045	-0045	edh/geogrpahie:2688	Ategua Córdoba Santa Cruz, {Teba la Vieja}	37.7552073 77	- 4.57292675 9	Cn. Magnus
edh/inschrift: hd029986	edh/person:hd029986/1	-0045	-0045	edh/geogrpahie:2688	Ategua Córdoba Santa Cruz, {Teba la Vieja}	37.7552073 77	- 4.57292675 9	Cn. Magnus
edh/inschrift: hd029989	edh/person:hd029989/1	-0045	-0045	edh/geogrpahie:2688	Ategua Córdoba Santa Cruz, {Teba la Vieja}	37.7552073 77	- 4.57292675 9	Cn. Magnus

inscription	person	startDate	endDate	place	label	latitude	longitude	name
edh/inschrift: hd000936	edh/person:hd000936/2	-0045	-0045	edh/geogrpahie:2892	Carteia El Rocadillo Cortijo de El Rocadillo; casa de Torre Cartagena	36.183163	-5.410358999	M. Licinius
edh/inschrift: hd000936	edh/person:hd000936/1	-0045	-0045	edh/geogrpahie:2892	Carteia El Rocadillo Cortijo de El Rocadillo; casa de Torre Cartagena	36.183163	-5.410358999	M. Petrucidius
edh/inschrift: hd031733	edh/person:hd031733/1	-0045	-0045	edh/geogrpahie:2620	Urso, bei Osuna, bei	37.236970	-5.102748	Cn. Magnus
edh/inschrift: hd029986	edh/person:hd029986/1	-0045	-0045	edh/geogrpahie:2688	Ategua Córdoba Santa Cruz, {Teba la Vieja}	37.755207377	-4.572926759	Cn. Magnus
edh/inschrift: hd029701	edh/person:hd029701/1	-0030	0050	edh/geogrpahie:2258	Castro del Río	37.69125	-4.48058	Iulia
edh/inschrift: hd030389	edh/person:hd030389/1	-0030	-0014	edh/geogrpahie:3340	Ipagrum, bei Puente Genil, bei cortijo del Lagar de S. Francisco	37.515020999	-4.656038999	Aecia Nice
edh/inschrift: hd010992	edh/person:hd010992/1	-0030	0014	edh/geogrpahie:3340	Ipagrum, bei Puente Genil, bei cortijo del Lagar de S. Francisco	37.515020999	-4.656038999	Aecia Nice
edh/inschrift: hd032162	edh/person:hd032162/1	-0030	0050	edh/geogrpahie:2227	Astigi, bei Camorra de las Cabezuelas	37.540931999	-5.079949	N. Cornelius
edh/inschrift: hd026620	edh/person:hd026620/2	-0030	0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Denatia (= Dentatia?)
edh/inschrift: hd026620	edh/person:hd026620/1	-0030	0001	edh/geogrpahie:2345	Corduba Córdoba	37.88333	-4.76667	Dionisia (= Dionysia)

Analytical query 4: Languages and scripts of the coins minted in Gades.

coin_type	start Date	endDate	obverse_language	obverse_text	obverse_script	obverse_type	reverse_language	reverse_text	reverse_script	reverse_type
erub/coin_type/gades/34616001	-300	-237					bm/id/thesauri/language/phoenician	lamed	bm/id/thesauri/script/phoenician	Topony m ?
erub/coin_type/gades/58292771	-300	-237					bm/id/thesauri/language/phoenician	mem	bm/id/thesauri/script/phoenician	Topony m ?
erub/coin_type/gades/78041982	-300	-237					bm/id/thesauri/language/phoenician	resch	bm/id/thesauri/script/phoenician	Topony m ?
erub/coin_type/gades/80212891	-300	-237					bm/id/thesauri/language/phoenician	beth	bm/id/thesauri/script/phoenician	Topony m ?
erub/coin_type/gades/93391252	-300	-237					bm/id/thesauri/language/phoenician	peh	bm/id/thesauri/script/phoenician	Topony m ?
erub/coin_type/gades/14961796	-237	-206					bm/id/thesauri/language/phoenician	mp`l / `gdr	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/22330774	-237	-206					bm/id/thesauri/language/phoenician	aleph	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/25778303	-237	-206					bm/id/thesauri/language/phoenician	mp`l / `gdr	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/27074319	-237	-206					bm/id/thesauri/language/phoenician	mhlm / `gdr	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/60168796	-206	-27					bm/id/thesauri/language/phoenician	p`lt	bm/id/thesauri/script/phoenician	Admin. Formula

coin_type	startDate	endDate	obverse_language	obverse_text	obverse_script	obverse_type	reverse_language	reverse_text	reverse_script	reverse_type
erub/coin_type/gades/60168796	-206	-27					bm/id/thesauri/language/neo-punic	hgdr	bm/id/thesauri/script/neo-punic	Topony m
erub/coin_type/gades/60286939	-206	-27					bm/id/thesauri/language/phoenician	mp`l / `gdr	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/60959144	-206	-27					bm/id/thesauri/language/phoenician	aleph / mp`l `gdr	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/63583886	-206	-27					bm/id/thesauri/language/phoenician	p`lt	bm/id/thesauri/script/phoenician	Admin. Formula
erub/coin_type/gades/63583886	-206	-27					bm/id/thesauri/language/neo-punic	gdr	bm/id/thesauri/script/neo-punic	Topony m
erub/coin_type/gades/65122631	-206	-27					bm/id/thesauri/language/phoenician	mem / aleph	bm/id/thesauri/script/phoenician	Toonym ?
erub/coin_type/gades/68355658	-206	-27					bm/id/thesauri/language/phoenician	mp`l	bm/id/thesauri/script/phoenician	Admin. Formula
erub/coin_type/gades/68355658	-206	-27					bm/id/thesauri/language/neo-punic	`gdr	bm/id/thesauri/script/neo-punic	Topony m
erub/coin_type/gades/76123383	-206	-27					bm/id/thesauri/language/phoenician	mp`l / `gdr	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/77829649	-206	-27					bm/id/thesauri/language/phoenician	mp`l / `gdr	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/77893470	-206	-27					bm/id/thesauri/language/phoenician	mp`l	bm/id/thesauri/script/phoenician	Admin. Formula

coin_type	startDate	endDate	obverse_language	obverse_text	obverse_script	obverse_type	reverse_language	reverse_text	reverse_script	reverse_type
erub/coin_type/gades/77893470	-206	-27					bm/id/thesauri/language/neo-punic	hgdr	bm/id/thesauri/script/neo-punic	Toponym
erub/coin_type/gades/82084909	-206	-27					bm/id/thesauri/language/phoenician	mem / aleph	bm/id/thesauri/script/phoenician	Topoym + Admin. Formula
erub/coin_type/gades/25471394	-19	-19					bm/id/thesauri/language/latin	MVNICIPI (PATRONVS) PARENS	bm/id/thesauri/script/latin	Admin. Formula
erub/coin_type/gades/3251576	-19	-19					bm/id/thesauri/language/latin	M AGRIPPA COS III	bm/id/thesauri/script/latin	Authority
erub/coin_type/gades/25471394	-19	-19	bm/id/thesauri/language/latin	AGRIPPA	bm/id/thesauri/script/latin	Authority				
erub/coin_type/gades/3251576	-19	-19	bm/id/thesauri/language/latin	MVNCI PARENS	bm/id/thesauri/script/latin	Authority				
erub/coin_type/gades/34305237	-19	-19	bm/id/thesauri/language/latin	AGRIPPA	bm/id/thesauri/script/latin	Authority				
erub/coin_type/gades/40235151	-19	-19	bm/id/thesauri/language/latin	AGRIPPA	bm/id/thesauri/script/latin	Authority				
erub/coin_type/gades/48651651	-19	-19	bm/id/thesauri/language/latin	MVNCI PARENS	bm/id/thesauri/script/latin	Authority				
erub/coin_type/gades/8491230	-19	-19	bm/id/thesauri/language/latin	MVNCI PARENS	bm/id/thesauri/script/latin	Authority				

coin_type	startDate	endDate	obverse_language	obverse_text	obverse_script	obverse_type	reverse_language	reverse_text	reverse_script	reverse_type
erub/coin_type/gades/86240790	-19	-19	bm/id/thesauri/language/latin	AGRIPPA	bm/id/thesauri/script/latin	Authority				
erub/coin_type/gades/14649232	-14	37					bm/id/thesauri/language/latin	AVGVSTVS DIVI F.	bm/id/thesauri/script/latin	Authority
erub/coin_type/gades/20014512	-14	37					bm/id/thesauri/language/latin	T1 CLAVDIVS (NERO)	bm/id/thesauri/script/latin	Authority
erub/coin_type/gades/2141064	-14	37					bm/id/thesauri/language/latin	T1 CLAVDIVS	bm/id/thesauri/script/latin	Authority
erub/coin_type/gades/43704895	-14	37					bm/id/thesauri/language/latin	AVGVSTVS DIVI F.	bm/id/thesauri/script/latin	Authority
erub/coin_type/gades/44887304	-14	37					bm/id/thesauri/language/latin	T1 CLAVDIVS	bm/id/thesauri/script/latin	Authority
erub/coin_type/gades/78268224	-14	37					bm/id/thesauri/language/phoenician	gdr	bm/id/thesauri/script/phoenician	Toponym
erub/coin_type/gades/78268224	-14	37					bm/id/thesauri/language/latin	COL A GAD	bm/id/thesauri/script/latin	Admin. Formula
erub/coin_type/gades/82134787	-14	37					bm/id/thesauri/language/latin	AVGVSTVS DIVI F.	bm/id/thesauri/script/latin	Authority
erub/coin_type/gades/21867439	-14	37	bm/id/thesauri/language/latin	AVGVSTVS	bm/id/thesauri/script/latin	Authority				
erub/coin_type/gades/44887304	-14	37	bm/id/thesauri/language/latin	NERO	bm/id/thesauri/script/latin	Authority				

Analytical query 5: Mints that present similar Punic-related administratrive formulae.

mint	reverse_language	reverse_script	reverse_text	reverse_type
nm:asido	bm/id/thesauri/language/neo-punic	bm/id/thesauri/script/neo-punic	b'b'l / sdn	Toponym + Ethnonym
nm:asido	bm/id/thesauri/language/neo-punic	bm/id/thesauri/script/neo-punic	b'b'l / sdn	Toponym + Ethnonym
nm:asido	bm/id/thesauri/language/neo-punic	bm/id/thesauri/script/neo-punic	b'b'l / sdn	Toponym + Ethnonym
nm:asido	bm/id/thesauri/language/neo-punic	bm/id/thesauri/script/neo-punic	b'b'l / sdn	Toponym + Ethnonym
nm:asido	bm/id/thesauri/language/neo-punic	bm/id/thesauri/script/neo-punic	sdnb'l/'sdn/ s(b) b' l' / b'b'l	Toponym + Ethnonym
nm:asido	bm/id/thesauri/language/neo-punic	bm/id/thesauri/script/neo-punic	sdnb'l/'sdn/ s(b) b' l' / b'b'l	Toponym + Ethnonym
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	aleph / mp`l `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	aleph / mp`l `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula

mint	reverse_language	reverse_script	reverse_text	reverse_type
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	aleph / mp`l `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	aleph / mp`l `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula

mint	reverse_language	reverse_script	reverse_text	reverse_type
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l	Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mp`l / `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	mpl/ `gdr / aleph	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	crescent / aleph / mp`l `gdr	Topoym + Admin. Formula
nm:gades	bm/id/thesauri/language/phoenician	bm/id/thesauri/script/phoenician	crescent / aleph / mp`l `gdr	Topoym + Admin. Formula
nm:sexsi	bm/id/thesauri/language/punic	bm/id/thesauri/script/punic	mp'l / sks	Toponym + Admin. Formula
nm:sexsi	bm/id/thesauri/language/punic	bm/id/thesauri/script/punic	mp'l / sks	Toponym + Admin. Formula
nm:tagilit	bm/id/thesauri/language/punic	bm/id/thesauri/script/punic	mp'l	Admin. Formula
nm:tagilit	bm/id/thesauri/language/punic	bm/id/thesauri/script/punic	mp'l	Admin. Formula

Analytical query 6: Mints with bilingual legends.

coin_type	obv_text	obv_lang	rev_text	rev_lang
Abdera coin series 3-7	CAESAR DIVI AUSGUSTUS	Latin	´bdrt	neo-punic
Abra coin series 2-2	ABRA	Latin	u.e.ko.e.ki / k.i.o.n.is	Southern-Iberian
Arsa coin series 1-1	a -RSA	Latin	w´r/s	neo-punic/libio-phoenician
Arsa coin series 1-1	a -RSA	Latin	(p)b´l	neo-punic
Asido coin series 1-1	ASIDO	Latin	sdnb'l	neo-punic
Asido coin series 2-2	ASIDO	Latin	sdnb'l/'sdn/ s(b) b' l' / b'b'l	neo-punic
Asido coin series 3-6	ASIDO	Latin	b'b'l / sdn	neo-punic
Carteia (Ckarteia) coin series 24-47	CARTEIA / EX D. D.	Latin/Punic	C. MAIUS C POLLIO III VIR	Latin
Carteia (Ckarteia) coin series 25-A-48	EX D. D.	Punic	L. ATINI C. NUCIA III VIR	Latin
Carteia (Ckarteia) coin series 25-B-49	EX D. D.	Punic	L. ATINI C. NUCIA III VIR	Latin
Iptuci coin series 2-3	IPTVCI	Latin	ys'wd'by	neopounic
Iptuci coin series 2-4	IPTVCI	Latin	ys'wd'by	neopounic
Kastilo (Castulo) coin series 6-32	VOC·ST(·F)·N	Latin	Ka.s.ti.l.o.	Southern Iberian
Kastilo (Castulo) coin series 6-33	VOC·ST(·F)·N	Latin	Ka.s.ti.l.o.	Southern Iberian
Kastilo (Castulo) coin series 6-36	VOC·ST(·F)	Latin	Ka.s.ti.l.o.	Southern Iberian
Kastilo (Castulo) coin series 8-39	M. ISC / C. AEL	Iberian	M. FVL.	Latin
Kastilo (Castulo) coin series 9-43	M. BAL. F.	Iberian	M. Q. F.	Latin
Lascuta coin series 1-1	LASCVT	Latin	iskw´t?	Punic
Lascuta coin series 2-B-5	LASCVT	Latin	Iskwt?	Punic

coin_type	obv_text	obv_lang	rev_text	rev_lang
Mvrtili/Mirtiles coin series 1-1	A / MVRT	Latin	L. AP. D	Punic
Mvrtili/Mirtiles coin series 1-2	MVRT / A (inverted)	Latin	L. AP. DEC	Punic
Mvrtili/Mirtiles coin series 2-4	MVRT / A (inverted)	Latin	L. AP. D	Punic
Mvrtili/Mirtiles coin series 3-5	MVRTIL	Latin	L. APDE	Punic
Mvrtili/Mirtiles coin series 4-6	MVRTIL	Latin	L. AC. NA	Punic
Obulco/Ibolka coin series 1-3	t.i.n.e.k.a.	Southern-Iberian	ATITAM	Latin
Obulco/Ibolka coin series 1-3	t.i.n.e.k.a.	Southern-Iberian	OBVLCO	Latin
Obulco/Ibolka coin series 2-4	OBVLCO	Latin	i.b.o.l.k.a.	Southern-Iberian
Obulco/Ibolka coin series 3-5	OBVLCO	Latin	s.i.bi.bo.l.a.i.	Southern-Iberian
Obulco/Ibolka coin series 4-A-8	OBVLCO	Latin	s.i.k.a.a.i. o.t.a.ti.i.ś.	Southern-Iberian
Obulco/Ibolka coin series 4-B-9	OBVLCO	Latin	i.l.ti.ŕ.a.t.i.n k.o.l.o.n.	Southern-Iberian
Obulco/Ibolka coin series 4-C-10	OBVLCO	Latin	i.s.ke.r.a.ti.n. tu.i.tu.bo.l.a.i.	Southern-Iberian
Obulco/Ibolka coin series 4-D-13	UBVLOO	Latin	tu.i.tu.i.bo.r.e.n. / G22a-n.tu.a.ko.i	Southern-Iberian
Obulco/Ibolka coin series 4-E-14	UBVLOO	Latin	i.l.ti.ŕ.e.u.r / ka. -G20- .su.ri.tu.	Southern-Iberian
Obulco/Ibolka coin series 4-F-15	OBVLCO	Latin	bo.ti.l.ko.ś / G21a-ko.e.ki	Southern-Iberian
Obulco/Ibolka coin series 4-G-16	OBVLCO	Latin	u.r.ka.i.l.tu. / n.e.s.e.l.tu.ko	Southern-Iberian
Obulco/Ibolka coin series 4-G-20	BODILCOS	Iberian	VIINIIT	Latin
Obulco/Ibolka coin series 5-B-29	OBVLCO	Latin	i.bo.l.ka.	Southern-Iberian
Obulco/Ibolka coin series 6-A-39	OBVL	Latin	Ka.s.	Southern-Iberian
Obulco/Ibolka coin series 6-B-41	-	Southern-Iberian	OBVLCO	Latin

coin_type	obv_text	obv_lang	rev_text	rev_lang
Sacili coin series 2-3	SACILI	Latin	s'gl	Punic
Sacili coin series 2-4	SACILI	Latin	Unread	Punic
Sacili coin series 3-5	SACILI	Latin	s'gl	Punic
Salacia-Ketovion coin series 2-3	ODACIS A	Latin	be.u.i.bu.n	Tartessian? Suldustian
Salacia-Ketovion coin series 3-5	CANDNIL SISCRA F	Latin	be.u.i.bu.n	Tartessian? Suldustian
Salacia-Ketovion coin series 3-6	CANDNI(L)	Latin	be.u.i.bu.n	Tartessian? Suldustian
Salacia-Ketovion coin series 4-7	SISBE SISCRA	Latin	be.u.i.bu.n	Tartessian? Suldustian
Salacia-Ketovion coin series 6-9	ANDVGEP. SISVC. F / TVL	Latin	be.u.i.bu.n	Tartessian? Suldustian
Salacia-Ketovion coin series 7-10	SISVCVRHIL	Latin	be.u.i.bu.n	Tartessian? Suldustian
Salacia-Ketovion coin series 8-11	CANTNIP. ED[NI]AE. F.	Latin	be.u.i.bu.n	Tartessian? Suldustian
Salacia-Ketovion coin series 8-12	CORANI	Latin	be.u.i.bu.n	Tartessian? Suldustian
Vesci coin series 2-3	VESCI	Latin	w'hsk	neopunic

Analytical query 7: Main iconographic types represented in the mints.

Mint	Start_date	End_date	Obverse_ico	Reverse_ico
Abdera	-200	-100	Herakles-Melqart	dolphin/tuna
Abra	-200	-100	Woman head with bun. Tannit?	ear and plough
Acci	-27	41	Augustus	legionary eagle
Acinippo	-100	-100	Grapes	two ears
Aipora	-100	-100	Herakles-Melqart	two fishes /tarpon?
Alba	-100	-100	Herakles-Melqart / Vulcan	dolphin/tuna/bull
Arsa/Arse	-100	-100	Male head with big eye.	ear
Asido	-200	-100	Baal-Hammon/ sun with rays Crown /Tannit/Melqart.	bull/crescent
Asta	-200	-100	Herakles-Melqart	tuna
Baesuri	-100	-100	Ear	tuna
Baicipo	-100	-100	Grapes	leaves
Bailo	-100	-100	Herakles-Melqart	ear/bull
Balleia	-100	-100	Male/Female head with rays Crown.	stars/crescent
Balsa			Tuna	ship
Baria	-225	-200	Tannit	palm tree
Bora	-200	-100	Astarté /Ceres	bull
Brutobriga	-200	-200	Male head	ship
Callet	-200	-100	Herakles-Melqart	ears
Carbula	-200	-100	Male head/woman head/Tannit?/Apollo	lire
Carisa	-100	-100	Male head/Herakles-Melqart	horseman with shield typical from ulterior.
Carmo	-200	-200	Female/Male head /Mercury?	ears
Carteia	-200	-100	Jupiter Baal-Hammon/ Tannit-Tyche	ship and dolphin

Mint	Start_date	End_date	Obverse_ico	Reverse_ico
Caura	-200	-200	female head with helmet (cimera) Artemis/Tannit?	fish
Celti	-200	-200	male head with wreath or hair band right	boar
Cerit	-100	-100	female head with bun and rays left	ears
Corduba/Colonia Patricia	-200	-100	female head with bun right	eros
Cun(v)baria	-100	-100	male head	tuna-fish right.
Detumo-sisipo	-200	-100	head	bull right/left
Ebora	-100	-100	Augustus	
Gades	-300	100	Melqart	tuna
iliberri ilbeŕiŕ, ilturiŕ	-300	-200	male head right / female head/stars	sphinx right
Ilipa (Magna) Ilipense	-200	-100	ear	tarpon right/ left
Ilipla	-100	-100	horse	two ears left
Ilipula	-100	-100	Mercury?	boar right in crescent
Iliturgi	-200	-200	male head	horseman with palm, left.
Ilse	-200	-200	ear right	tarpon left
Iltiraca	-200	-200	male head right with infulae	woolf
Ilurco	-200	-200	male head right	male head right
Iptuci	-100	-100	Herakles-Melqart	wheel with eight ratios and inner circle
Irippo	-100	-100	Octavian?	seated female deitiy with cornucopia and peanut, laurea? tannit-caelistis?
Italica	-100	100	Roman emperors heads	altar
Ituci	-100	-100	ears	horseman
Kastilo (Castulo/Kastilo)	-300	-100	male head right	bull right
Lacipo	-100	-100	Bull/ Baal-Haamon/Tannit	dolphin left

Mint	Start_date	End_date	Obverse_ico	Reverse_ico
Laelia	-200	-100	Male head / horse	palm
Lascuta	-150	-100	Hercules-Herakles-Melqart head left with lion skin and club on the shoulder	elephant/tuna
Lastigi	-200	-200	head with helmet right. vegetable decoration and laurea.	ears
Malaka	-300	-100	male head right with pileus and tongs	rays star
Mvrtili/Mirtiles	-200	-200	tarpon right	ear right
Nabrisa	-100	-100	male head right	horse right
Oba	-200	-100	male/female head right	horse
Obulco/Ibolka	-300	-100	female head right with bun and necklace	bull
Olontigi	-200	-100	male head right	pineapple/ horseman
Onuba	-100	-100	female head right with helmet	two ears right
Oquri	-100	-100	male head with beard and hairband Ba'al Hamon?	scepter crescent globule and stars
Oretum	-100	-100	mining peak and mining hook right	bunch of grapes
Orippo	-200	-100	bunch of grapes	bull
Osset	-200	-100	male head right/left - female head	standing figure naked
Ostur	-200	-100	acorn	boar, acorn, ears
Pax Iulia	-100	-100	male head right	seated female figure left holding cornucopia and caduceus
Romula	-100	100	Roman emperors heads	
Sacili	-200	-150	wreathed male head Silenus.	horse / elephant
Salacia-Ketovion	-200	-100	Herakles-Melqart head left with lion skin and club --> Neptune	tuna
Salpesa	-100	-100	Apollonian female head right	tripode, lire, arch
Searo	-200	-100	Herakles-Melqart	ears

Mint	Start_date	End_date	Obverse_ico	Reverse_ico
Sexs	-300	-100	Herakles-Melqart/Tannit	tuna
Sirpense	-200	-200	dolphin right with trident and crescent	star
Sisapo			male head	boar/tuna right
Tagilit	-300	-200	female head right	ignot
Traducta	-100	-100	Roman emperors heads	
Turris	-200	-100	female deity	weapon (god sacred elements?)
Ulia/Ugia			female deity	globule star
Urso	-200	-200	male head laureate right	sphinx/bear
Ventipo	-200	-200	head with helmet right	standing solder with helmet, shield and spear. (unparalleled)
Vesci	-150	-100	male head naked right and spear	bull
Vlia/Ulia	-200	-200	female head with bun and necklace	vine shoot

Analytical query 8: most represented deities in the coin-types together with DBpedia URIs and wikimedia commons images.

Nomisma mint ID	latitude	longitude	number_of_coin_type	god	depiction
nm:gades	36.533333	-6.29	134	dbpedia:Melqart	
nm:gades	36.533333	-6.29	67	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:carteia	36.183163	-5.410359	29	dbpedia:Baal_Hammon	
nm:carteia	36.183163	-5.410359	29	dbpedia:Jupiter_(mythology)	
nm:carteia	36.183163	-5.410359	29	dbpedia:Jupiter_(mythology)	wiki/Special:FilePath/Giove,_I_sec_dc,_con_parti_simulanti_il_bronzo_moderne_02.JPG
nm:carteia	36.183163	-5.410359	29	dbpedia:Baal_Hammon	wiki/Special:FilePath/Terracotta_statue_of_Baal-Hammon_on_a_throne_AvL.JPG
nm:salacia	38.371152	-8.519503	16	dbpedia:Melqart	
nm:iptuci	36.789695	-5.555577	8	dbpedia:Melqart	
nm:carisa	36.877668	-5.732101	8	dbpedia:Melqart	
nm:salacia	38.371152	-8.519503	8	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:carteia	36.183163	-5.410359	6	dbpedia:Melqart	
nm:abdera_hispania	36.733333	-3.016667	6	dbpedia:Melqart	
nm:carmo	37.471001	-5.642257	6	dbpedia:Melqart	
nm:julia_traducta	36.129768	-5.447744	6	dbpedia:Augustus	wiki/Special:FilePath/Statue-Augustus.jpg
nm:irippo	37.001163	-5.391451	5	dbpedia:Augustus	wiki/Special:FilePath/Statue-Augustus.jpg
nm:colonia_patricia	37.884683	-4.779171	5	dbpedia.org/resource/Augustus	wiki/Special:FilePath/Statue-Augustus.jpg
nm:sexsi	36.734589	-3.690755	4	dbpedia:Melqart	

Nomisma mint ID	latitude	longitude	number_of_coin_type	god	depiction
nm:iptuci	36.789695	-5.555577	4	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:carisa	36.877668	-5.732101	4	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:carisa	36.877668	-5.732101	4	dbpedia:Heracles	wiki/Special:FilePath/Hercules_Farnese_3637104088_9c95d7fe3c_b.jpg
nm:carteia	36.183163	-5.410359	3	dbpedia:Mercury_(mythology)	
nm:carbula	37.809644	-5.019918	3	dbpedia:Apollo	wiki/Special:FilePath/Apollo_of_the_Belvedere.jpg
nm:carteia	36.183163	-5.410359	3	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:abdera_hispania	36.733333	-3.016667	3	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:carmo	37.471001	-5.642257	3	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:carteia	36.183163	-5.410359	3	dbpedia:Heracles	wiki/Special:FilePath/Hercules_Farnese_3637104088_9c95d7fe3c_b.jpg
nm:carmo	37.471001	-5.642257	3	dbpedia:Heracles	wiki/Special:FilePath/Hercules_Farnese_3637104088_9c95d7fe3c_b.jpg
nm:carteia	36.183163	-5.410359	3	dbpedia:Mercury_(mythology)	wiki/Special:FilePath/S03_06_01_020_image_2551.jpg
nm:gades	36.533333	-6.29	3	dbpedia:Augustus	wiki/Special:FilePath/Statue-Augustus.jpg
nm:irippo	37.001163	-5.391451	3	dbpedia:Tiberius	wiki/Special:FilePath/Tiberius,_Romisch-Germanisches_Museum,_Cologne_(8115606671).jpg
nm:abra	37.765419	-3.959262	3	dbpedia:Tanit	wiki/Special:FilePath/Tophet_Carthage.2.jpg
nm:asido	36.467791	-5.927867	2	dbpedia:Melqart	
nm:aipora	36.779174	-6.354245	2	dbpedia:Melqart	
nm:abdera_hispania	36.733333	-3.016667	2	dbpedia:Mercury_(mythology)	

Nomisma mint ID	Nomisma mint ID	Nomisma mint ID	Nomisma mint ID	Nomisma mint ID	Nomisma mint ID
nm:carmo	37.471001	-5.642257	2	dbpedia:Mercury_(mythology)	
nm:sexsi	36.734589	-3.690755	2	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:abdera_hispania	36.733333	-3.016667	2	dbpedia:Mercury_(mythology)	wiki/Special:FilePath/S03_06_01_020_image_2551.jpg
nm:carmo	37.471001	-5.642257	2	dbpedia:Mercury_(mythology)	wiki/Special:FilePath/S03_06_01_020_image_2551.jpg
nm:gades	36.533333	-6.29	2	dbpedia:Tiberius	wiki/Special:FilePath/Tiberius,_Romisch-Germanisches_Museum,_Cologne_(8115606671).jpg
nm:abdera_hispania	36.733333	-3.016667	2	dbpedia:Tiberius	wiki/Special:FilePath/Tiberius,_Romisch-Germanisches_Museum,_Cologne_(8115606671).jpg
nm:romula	37.382668	-5.996293	2	dbpedia:Tiberius	wiki/Special:FilePath/Tiberius,_Romisch-Germanisches_Museum,_Cologne_(8115606671).jpg
nm:baria	37.246625 53299897	- 1.77287578 58275908	2	dbpedia:Tanit	wiki/Special:FilePath/Tophet_Carthage.2.jpg
nm:carbula	37.809644	-5.019918	2	dbpedia:Tanit	wiki/Special:FilePath/Tophet_Carthage.2.jpg
nm:halos	37.166667	-4.15	1	dbpedia:Mercury_(mythology)	
nm:asido	36.467791	-5.927867	1	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:aipora	36.779174	-6.354245	1	dbpedia:Melqart	wiki/Special:FilePath/Dishekel_hispano-cartaginés-2.jpg
nm:abdera_hispania	36.733333	-3.016667	1	dbpedia:Heracles	wiki/Special:FilePath/Hercules_Farnese_3637104088_9c95d7fe3c_b.jpg
nm:callet	37.052305	-5.626201	1	dbpedia:Heracles	wiki/Special:FilePath/Hercules_Farnese_3637104088_9c95d7fe3c_b.jpg
nm:irippo	37.001163	-5.391451	1	dbpedia:Germanicus	wiki/Special:FilePath/MSR_-_Germanicus_Inv._30010.jpg
mint	**latitude**	**longitude**	**number_of_coin_type**	**god**	**depiction**

nm:romula	37.382668	-5.996293	1	dbpedia:Germanicus	wiki/Special:FilePath/MSR_-_Germanicus_Inv._30010.jpg
nm:irippo	37.001163	-5.391451	1	dbpedia:Roma_(mythology)	wiki/Special:FilePath/Roman_-_Coin_with_Denarius_with_Roma_-_Walters_59763.jpg
nm:osset	37.358375	-6.035436	1	dbpedia:Roma_(mythology)	wiki/Special:FilePath/Roman_-_Coin_with_Denarius_with_Roma_-_Walters_59763.jpg
nm:carmo	37.471001	-5.642257	1	dbpedia:Roma_(mythology)	wiki/Special:FilePath/Roman_-_Coin_with_Denarius_with_Roma_-_Walters_59763.jpg
nm:halos	37.166667	-4.15	1	dbpedia:Mercury_(mythology)	wiki/Special:FilePath/S03_06_01_020_image_2551.jpg
nm:romula	37.382668	-5.996293	1	dbpedia:Augustus	wiki/Special:FilePath/Statue-Augustus.jpg

Analytical query 9: Iconographic themes related to Herakles Melqart by mint.

number_of_ coin_type	Abreviated Nomisma ID for mint	lat	long	iconography
1	nm:carteia	36.183163	-5.410359	Male head with lion skin (Hercules/Melkart)
1	nm:callet	37.052305	-5.626201	Herakles head with lion skin
1	nm:carteia	36.183163	-5.410359	Head of Herakles-Melkart with lion skin two globules
2	nm:abdera_hispania	36.733333	-3.016667	male head right with club
5	nm:salacia	38.371152	-8.519503	Melkart head left with lion skin and club
1	nm:carteia	36.183163	-5.410359	club, arch and cacaj
2	nm:bailo			Herakles Melkart head with lion skin and ear left
1	nm:ilipa	37.360102	-6.679208	Ear right, dolphin, club?
2	nm:searo	37.052397	-5.751603	Hercules-Melkart head with lion skin right
3	nm:carmo	37.471001	-5.642257	Male head (Melkart Herakles) right with lion skin
1	nm:lascuta	36.460524	-5.723687	Hercules-Melkart head right with lion skin.
2	nm:carteia	36.183163	-5.410359	Head of Herakles-Melkart with lion skin
1	nm:gades	36.533333	-6.29	Head of Melkart frontal with lion skin.
13	nm:gades	36.533333	-6.29	Head of Melkart left with lion skin.
1	nm:castulo	38.037913	-3.624424	Male head right and club
1	nm:baria	37.24662553299897	-1.7728757858275908	female/male head with lion skin Tanit?
6	nm:gades	36.533333	-6.29	Head of Melkart left with lion skin
4	nm:gades	36.533333	-6.29	Head of Melkart right with lion skin.

number_of_coin_type	Abreviated Nomisma ID for mint	lat	long	iconography
3	nm:lascuta	36.460524	-5.723687	Hercules-Melkart head left with lion skin and club on the shoulder
1	nm:sexsi	36.734589	-3.690755	tuna right and club
1	nm:sexsi	36.734589	-3.690755	Male Head (Mlekart) right with lion skin
2	nm:sexsi	36.734589	-3.690755	Melkart-Herakles head left with club
1	nm:carisa	36.877668	-5.732101	Male head with lion skin
1	nm:salacia	38.371152	-8.519503	Melkart head with lion skin and club
1	nm:aipora	36.779174	-6.354245	male head with lion skin?
9	nm:sexsi	36.734589	-3.690755	Melkart-Herakles head left with lion skin and club
2	nm:sexsi	36.734589	-3.690755	horizontal club
1	nm:carteia	36.183163	-5.410359	club and two globules
1	nm:carteia	36.183163	-5.410359	club and three globules
2	nm:lascuta	36.460524	-5.723687	Hercules-Melkart head right with lion skin and club.
2	nm:salacia	38.371152	-8.519503	Melkart head left with lion skin and club on shoulder
1	nm:asido	36.467791	-5.927867	Male head (Melkart) with lion skin and club
4	nm:iptuci	36.789695	-5.555577	Melkart head wit lion skin right
1	nm:sexsi	36.734589	-3.690755	Male Head (Mlekart) right/left and club
41	nm:gades	36.533333	-6.29	Head of Melkart left with lion skin and club

Analytical query 10: Occurrences of iconographic themes by mint.

mint	number	iconography
nm:gades	41	Head of Melkart left with lion skin and club
nm:carteia	20	Male head with beard (Jupiter/ Baal-Hammon)
nm:obulco	15	Female head right with bun and necklace
nm:carteia	15	Female head with tower-wreath (Tyche-Tanit) and trident
nm:carteia	14	Ship prow
nm:gades	13	Head of Melkart left with lion skin.
nm:castulo	12	bull right crescent
nm:carteia	11	Dolphin
nm:castulo	9	Male head with hairband right
nm:sexsi	9	Melkart-Herakles head left with lion skin and club
nm:iptuci	9	Wheel with eight ratios and inner circle
nm:gades	9	tuna right
nm:malaca	8	tetrastile temple
nm:gades	8	tuna left
nm:gades	8	two tunas left
nm:castulo	7	Male head right and palm
nm:malaca	7	Male head right with pileus and tongs
nm:gades	7	dolphin left pierced by trident
nm:mirtiles	7	ear right

mint	number	iconography
nm:carmo	7	two ears
nm:gades	6	Acrostolium (improvements in the port carried out by Agrippa?)
nm:julia_traducta	6	Augustus head left
nm:sexsi	6	Female head with helmet (Astarte-Tanit)
nm:gades	6	Head of Melkart left with lion skin
nm:carteia	6	Male head laureate (Jupiter/ Baal-Hammon)
nm:olontigi	6	Male head right
nm:castulo	6	boar right star
nm:carisa	6	horse rider with helmet.
nm:mirtiles	6	sabalo right
nm:acinippo	6	two ears
nm:obulco	5	Apollonian head laureate right
nm:colonia_patricia	5	Augustus head looking left
nm:lastigi	5	Head with helmet right. Vegetable decoration and laurea.
nm:castulo	5	Male head laureate right
nm:urso	5	Male head laureate right
nm:salacia	5	Melkart head left with lion skin and club
nm:carteia	5	Ship prow and two stars
nm:ilipa	5	Vertical ear
nm:malaca	5	frontal bust with rays

mint	number	iconography
nm:castulo	5	sphinx with helmet right and star.
nm:salacia	5	two tunas right
nm:gades	4	Agrippa´s head with wreath
nm:irippo	4	Augustus head right
nm:obulco	4	Female head right with bun and necklace and crescent
nm:onuba	4	Female head right with helmet
nm:ulia	4	Female head with bun and necklace with palm crescent and bunch of grapes.
nm:caura	4	Femle head with helmet (cimera)
nm:caura	4	Fish and crescent
nm:gades	4	Head of Melkart right with lion skin.
nm:castulo	4	Male head left/right
nm:vesci	4	Male head naked right and spear
nm:osset	4	Male head right
nm:olontigi	4	Male head with dressed neck right
nm:iptuci	4	Melkart head wit lion skin right
nm:ilse	4	Sabalo left
nm:castulo	4	boar right
nm:castulo	4	bull right
nm:obulco	4	bull right
nm:olontigi	4	dolphin right

mint	number	iconography
nm:colonia_patricia	4	eros with wings left hand cornucopia, right hand banner with cross.
nm:malaca	4	sixteen rays star
nm:malaca	4	sixteen rays star within vegetable wreath
nm:onuba	4	two ears right
nm:gades	4	two tunas right
nm:sexsi	4	two tunas right
nm:obulco	3	Apollonian head laureate right with crescent
nm:gades	3	Augusuts head left laureate
nm:castulo	3	Bull right
nm:detumo_sisipo	3	Bull right/left
nm:obulco	3	Eagle with wings opened right
nm:ilse	3	Ear right
nm:castulo	3	Female head laureate right
nm:tagilit	3	Female head right
nm:colonia_patricia	3	Female head with bun right
nm:obulco	3	Female head with bun right
nm:colonia_patricia	3	Female head with bun right with three globules
nm:lascuta	3	Hercules-Melkart head left with lion skin and club on the shoulder
nm:olontigi	3	Horse rider right
nm:acci	3	Laureate head of Tiberius right

mint	number	iconography
nm:acci	3	Legionary eagle right between two insigne
nm:carmo	3	Male head (Melkart Herakles) right with lion skin
nm:castulo	3	Male head right
nm:pax_julia	3	Male head right
nm:sexsi	3	Male head right
nm:malaca	3	Male head right with polos and tongs
nm:castulo	3	Male head right/left
nm:carisa	3	Male head with beard
nm:malaca	3	Male head with beard and pileus right/left (Hephaestus) tongs and laurea
nm:malaca	3	Male head without beard and petaso left.
nm:malaca	3	Male head without beard and petaso right.
nm:baria	3	Palm tree with fruits
nm:olontigi	3	Pineapple left
nm:carteia	3	Ship rudder
nm:gades	3	Simpulum
nm:obulco	3	bull right and crescent
nm:obulco	3	bull right crescent
nm:asido	3	bull with star
nm:gades	3	bunch of rays with wings
nm:asido	3	dolphin with crescent

Analytical query 11: Iconographic themes represented in the sculptural record.

number_of_occurrences	iconography
17	human_figure
10	Togatus
9	Astarte_Tanit
8	warrior
6	Lion
5	Kerakles-Melqart smitting god
4	Female_figure
4	Female_head
4	bull
3	Eros
3	Male_portrait
3	Thoracatus
3	Vegetable_Decoration
3	lion
3	rabbit
3	ram
2	Augustus
2	Hercules
2	Male_bust

2	Male_figure
2	Satire
2	Trajan
2	griffin
2	horse
2	male_head
2	man
2	priest
2	seated_person
2	silenus
2	small_animal
2	soldier
2	soldiers
2	sphinx
2	standing_woman
1	Acrobat
1	Adrianus
1	Afrodita/Venus
1	Alexander_the_great
1	Amazone [Según_García_y_Bellidoy_1949:_168]_

	Dea_Roma [Según_Fernández_y_Fernándezy_1980:_44]
1	Artemis
1	Artemisia_of_the_Mausoleum_of_Halicarnassus
1	Astarté-Tannit
1	Athena?
1	Attis
1	Augusts
1	Bastetani_dancing
1	Black_man_under_a_lion
1	Bonus_eventus,_[God_or_protective_Genius_linked_to_success_and_good_omen]
1	Bull
1	Capital_with_volutes
1	Clodio_Albino
1	Diadumene
1	Dionysos
1	Divus_Iulius_Divus_Augustus
1	Druso_the_younger
1	Dyonisos
1	Egyptian_sphinx
1	Face
1	Female_bust

Analytical query 12: Sculptural objects with higher number of cultural associations in ERUB.

statue	number_of_associations	Sculpture Label	start Date	end Date	URI_musem_reference	iconography	museumcontext	location	locationLabel
erub/sculpture:ituci_virtus_iulia/dj030941	4	limestone sculpture	-200	-100	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MAECO&musid=7&ninv=DJ030941&volver=portal&k=torreparedones&tipoBusqueda=simple&lng=es	feline_head	erub:Iberian	pleiades:265938	I(p)tuci
erub/sculpture:ituci_virtus_iulia/dj030941	4	limestone sculpture	-200	-100	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MAECO&musid=7&ninv=DJ030941&volver=portal&k=torreparedones&tipoBusqueda=simple&lng=es	feline_head	erub:Roman	pleiades:265938	I(p)tuci
erub/sculpture:castulo/ce/da01684	3	limestone relief	-199	99	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MJA&musid=11&ninv=CE/DA01684&volver=portal&k=castulo&tipoBusqueda=simple&lng=es	Bastetani_dancing	erub:Iberian		
erub/sculpture:carteia/ce04884	3	terracotta bust + pedestal	1	200	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MCA&musid=2&ninv=CE04884&volver=portal&k=carteia&tipoBusqueda=simple&lng=es	godess	erub:Iberian	pleiades:256063	Carteia/Calpe/Karpessos
erub/sculpture:carteia/ce04884	3	terracotta bust + pedestal	1	200	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MCA&musid=2&ninv=CE04884&volver=portal&k=carteia&tipoBusqueda=simple&lng=es	godess	erub:Roman	pleiades:256063	Carteia/Calpe/Karpessos

statue	number_of_associations	Sculpture Label	start Date	end Date	URI_musem_reference	iconography	museumcontext	location	locationLabel
erub/sculpture:corduba/ce030144	3	marble Animal	1	25	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MAECO&musid=7&ninv=CE030144&volver=portal&k=corduba&tipoBusqueda=simple&lng=es	sphinx	erub:Roman	pleiades:256128	Corduba/Col. Patricia
erub/sculpture:gades/ce05087	3	terracotta Statue	67	99	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MCA&musid=2&ninv=CE05087&volver=portal&k=gades&tipoBusqueda=simple&lng=es	Gladiator	erub:Roman	pleiades:256177	Gadeira/Gades/Col. Augusta Gaditana
erub/sculpture:urso/38415	3	limestone relief	-299	-99	http://ceres.mcu.es/pages/Main?idt=31804&inventar/=38415&table=FMUS&museum=MAN	flaut_player/ Priestess	erub:Iberian	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:urso/38417	3	limestone relief	-99	-76	http://ceres.mcu.es/pages/Main?idt=31806&inventar/=©&table=FMUS&museum=MAN	cornicen_player	erub:Iberian	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:urso/38417	3	limestone relief	-99	-76	http://ceres.mcu.es/pages/Main?idt=31806&inventar/=©&table=FMUS&museum=MAN	cornicen_player	erub:Roman	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:urso/38421	3	limestone relief	-99	-76	http://ceres.mcu.es/pages/Main?idt=31810&inventar/=38421&table=FMUS&museum=MAN	Soldiers_fighting	erub:Iberian	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:urso/38421	3	limestone relief	-99	-76	http://ceres.mcu.es/pages/Main?idt=31810&inventar/=38421&table=FMUS&museum=MAN	Soldiers_fighting	erub:Roman	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:urso/am1125	3	limestone relief	-199	-100	http://www.culture.gouv.fr/public/mistral/joconde_fr?ACTION=CHERCHER&FIELD_1=REF&VALUE_1=50010015867	man	erub:Iberian	pleiades:256503	Urso/Col. Genetiva Iulia

statue	number_of_associations	Sculpture Label	start Date	end Date	URI_musem_reference	iconography	museumcontext	location	locationLabel
erub/sculpture:urso/am1125	3	limestone relief	-199	-100	http://www.culture.gouv.fr/public/mistral/joconde_fr?ACTION=CHERCHER&FIELD_1=REF&VALUE_1=50010015867	man	erub:Roman	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:urso/am1208	3	limestone relief	-100	-1	https://www.photo.rmn.fr/C.aspx?VP3=SearchResult&IID=2C6NU0TKQTZW	warrior_marching	erub:Greek	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:urso/am1208	3	limestone relief	-100	-1	https://www.photo.rmn.fr/C.aspx?VP3=SearchResult&IID=2C6NU0TKQTZW	warrior_marching	erub:Roman	pleiades:256503	Urso/Col. Genetiva Iulia
erub/sculpture:castulo/dj02880	2	Marble sculpture	76	150	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MALI&musid=12&ninv=DJ02880&volver=portal&k=castulo&tipoBusqueda=simple&lng=es	Female_head	erub:Roman		
erub/sculpture:castulo/ce00171	2	marble sculpture	1	300	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MALI&musid=12&ninv=CE00171&volver=portal&k=castulo&tipoBusqueda=simple&lng=es	Dyonisos	erub:Roman		
erub/sculpture:baria/ce14149	2	terracotta cauldron	-400	-200	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MAL&musid=6&ninv=CE14149&volver=portal&k=astarte&tipoBusqueda=simple&lng=es	Astarte_Tanit	erub:Phoenician		

statue	number_of_associations	Sculpture Label	start Date	end Date	URI_musem_reference	iconography	museumcontext	location	locationLabel
erub/sculpture:baria/ce14149	2	terracotta cauldron	-400	-200	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MAL&musid=6&ninv=CE14149&volver=portal&k=astarte&tipoBusqueda=simple&lng=es	Astarte_Tanit	erub:Punic		
erub/sculpture:castulo/ce00273	2	yellow_sandstone capitel	-500	-200	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MALI&musid=12&ninv=CE00273&volver=portal&k=astarte&tipoBusqueda=simple&lng=es	Astarte_Tanit	erub:Iberian		
erub/sculpture:castulo/ce00273	2	yellow_sandstone capitel	-500	-200	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MALI&musid=12&ninv=CE00273&volver=portal&k=astarte&tipoBusqueda=simple&lng=es	Astarte_Tanit	erub:Punic		
erub/sculpture:castulo/ce00278	2	yellow_terracota sculpture	1	300	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MALI&musid=12&ninv=CE00278&volver=portal&k=astarte&tipoBusqueda=simple&lng=es	Astarte_Tanit	erub:Iberian		
erub/sculpture:castulo/ce00278	2	yellow_terracota sculpture	1	300	http://www.juntadeandalucia.es/cultura/WEBDomus/fichaCompleta.do?acron=MALI&musid=12&ninv=CE00278&volver=portal&k=astarte&tipoBusqueda=simple&lng=es	Astarte_Tanit	erub:Punic		